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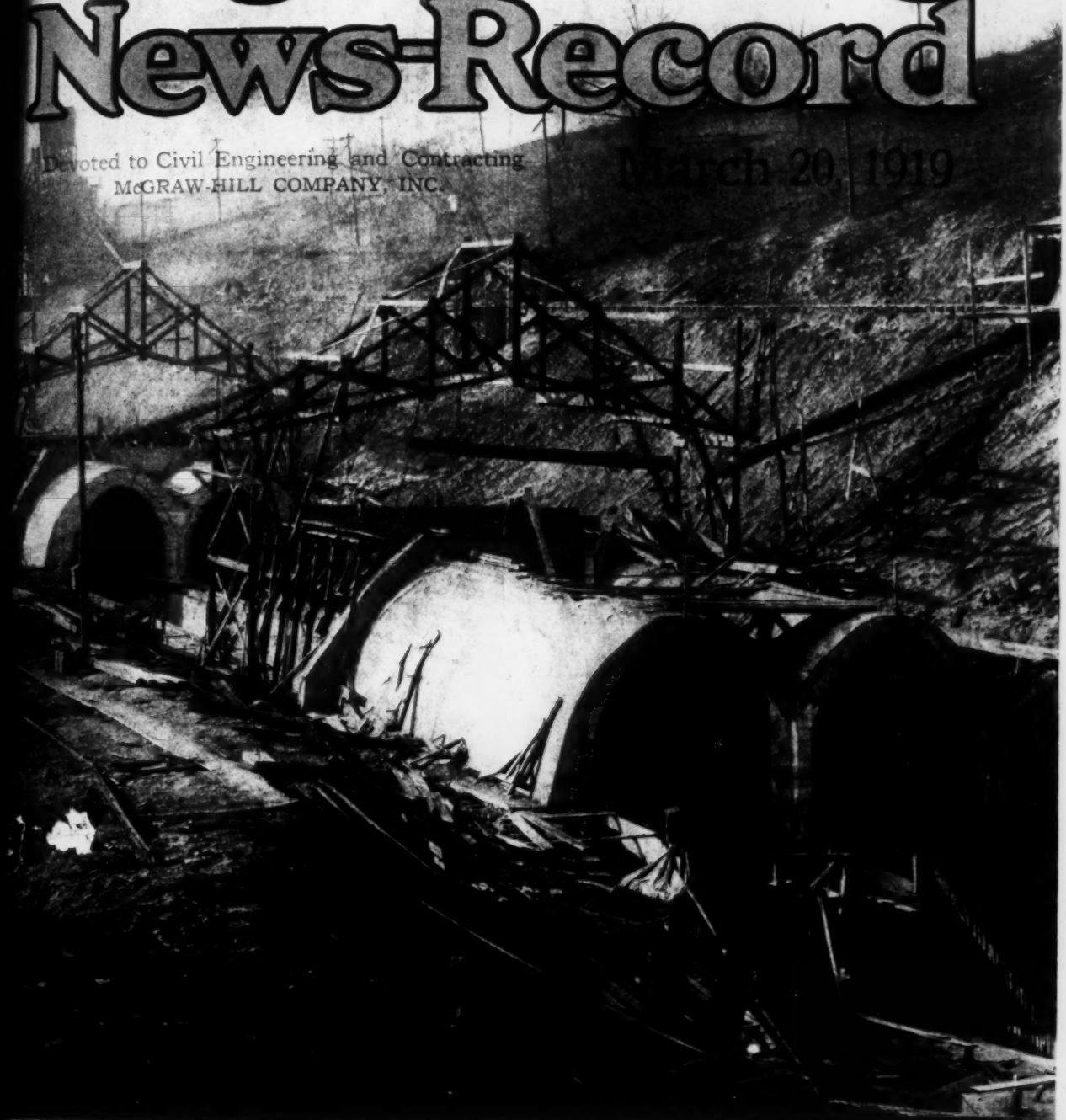


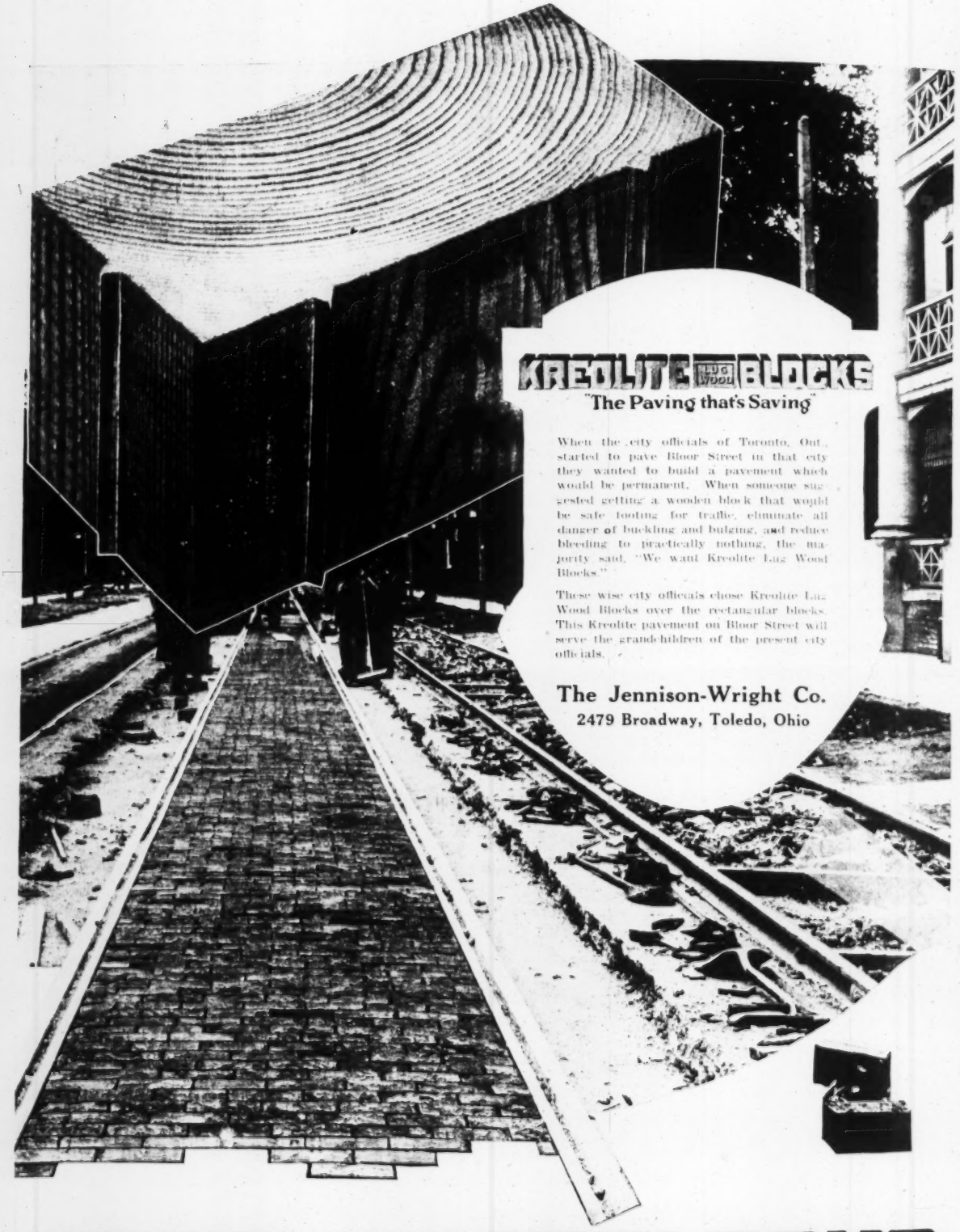
Plant for Building Fabricated Ships at Bristol

Keep Accurate Costs on Fee Contract
By Farley Gannett and J. D. Carpenter

Salt-Marsh Sand-Clay as Road-Building Material

Good Yard Layout Speeds Up Floating Dry Dock Construction

Travelers Shift Forms and Chutes in Concreting Outlet Conduits for Germantown Dam



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KREOLITE LUG WOOD BLOCKS
"The Paving that's Saving"

Volume 82 March 20, 1919 Number 12

Engineering News-Record

A CONSOLIDATION OF ENGINEERING NEWS AND ENGINEERING RECORD, WITH WHICH IS INCORPORATED THE CONTRACTOR.

E. J. MEHREN, *Editor*

CHARLES WHITING BAKER, *Consulting Editor*

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Published Weekly. Entered as second-class matter Apr. 11, 1917, at the Post Office at New York under the act of Mar. 3, 1879.

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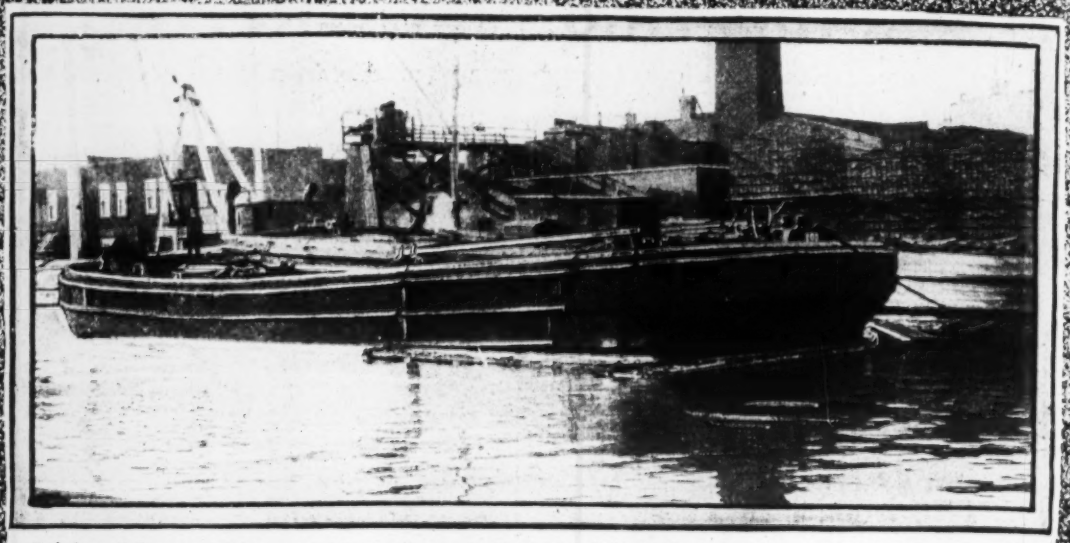

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, Editor — CHARLES WHITING BAKER, Consulting Editor

Volume 82 — NEW YORK, THURSDAY, MARCH 20, 1919 — Number 12

Meeting the Cost of Water-Main Extensions

HOW best to meet the cost of extending water mains is not so easy a question to answer as may appear at first thought. Practice varies widely and does not seem to be based on comprehensive scientific study. The path of least resistance is the one most likely to be followed. Beyond attempts to avoid legal pitfalls, local feeling seems to control. The policy of the water board or city council may be liberal or the reverse, according to whether there prevails the idea of water service to all on easy terms, or strict regard for revenue in excess of capital and operating charges. Or the practice may range between these two extremes. The variations thus far considered relate to the division of responsibility for extensions between individuals and the city. Where the individual property owners must bear the whole or part of the responsibility there still remains the question: Shall they pay the first cost of the extension, or shall they guarantee a revenue for water which shall be a stated percentage of the first cost? If the property owners pay all or part of the first cost, how shall it be apportioned among them? The easiest way is to adopt the pro rata frontage basis. Is it the fairest and best way? If the property owners voluntarily and unanimously agree to such a plan, perhaps no one need complain, but if the city must use compulsion on some property owners then the question arises, Is the plan equitable? The subject bristles with questions.

Assessment of Benefits Deserves More Attention

INCREASED attention might well be given to assessments for benefits, as a means of meeting the cost of water-main extensions. This proposition was brought before the New England Water-Works Association at Boston last week. The discussion, briefly summarized on p. 591, was quite extended, but it ranged over the broader field of paying for water-main extensions discussed in the note preceding this one, and showed the diversity of practice already mentioned. The discussion indicated that the practice of making individuals assume responsibility for water-main extensions is common, and that often it is the property owner rather than the water consumer who must shoulder the burden. The examples cited did not show that an out-and-out benefit plan is commonly used, but, rather, that where the property owners are made responsible frontage is the basis of dividing first cost. More commonly, it appeared, there is a voluntary assumption of responsibility, whether on a first-cost or a revenue-guarantee basis. The discussion, common observation and any considerable knowledge of human nature, combine to show that such a plan leads to unfairness. Sooner or later, those who assume none of the responsibility get water without bearing their share of the burden. Taking all the foregoing facts and opinions into account, as well as the increasing difficulty in finding money for municipal improvements, the case seems to be strong for a thoroughgoing study designed to show for a considerable number of water-works, well distributed geographically, what the current practice is as to meeting the cost of water-main extensions, the details of the assessment-for-benefits plan whenever it is used, and the wisdom of extending that plan. The study should include consideration of how the benefits-assessment plan may best be adapted to water-works conditions.

Lessons From Spring Breakups

TIMES of excessive moisture are generally admitted to be the most critical periods in the life of road surfacings. This was abundantly proved by the experiences of last spring, when large sections of roadway which had successfully carried equal or greater traffic over dry subgrades were broken through as the frost left the ground. As excessive moisture is the recognized cause of these failures, the least that can be done at such times is to keep the ditches open so that the saturation of the subgrade will not be increased by standing water. A second precaution which might well be employed is to regulate heavy traffic at the critical time. If roads which will carry the loads for 360 days in the year are broken down by the traffic in the other five, as was the case in some instances last spring, it would seem the height of maladministration to allow the same thing to occur again. While in many sections there is little depth of frost this year, due to the clemency of the past winter, there is certain to be a season of excessive moisture, and every effort should be put forth by highway officials during the next two months to safeguard the public investment.

Highway Lettings Should Be Expedited

EVIDENCE of delay in the authorization of projects and the preparation of plans for country highway and city paving is making its annual appearance. Although March is nearly gone and plans should be ready for the spring opening, little work is being advertised for letting. Much of this delay is no doubt due to the hope among officials that there will be a decline in the prices of highway materials. This is a mistaken policy, both because investigations by economists indicate no immediate prospect of such a movement, and because the monetary value to the communities of immediate use

of good roads would largely counterbalance any possible saving in the cost of road materials. The disadvantage of a late start in highway work is apparent to all engineers. It means late fall work, under frost conditions, and possibly a shut-down for the winter months, thus delaying the completion of the contract and the utilization by the public of the money already invested. To these arguments against delay may be added the patriotic incentive to help out in the unemployment situation confronting the nation. The road-building season is short at the best, and highway engineers should urge their commissioners, councils and boards of public works to expedite the lettings.

Some Mayors Need Education

IN THE last minutes of the recent Governors' and mayors' conference in Washington the presiding officer read a resolution signed by a number of the 130-odd mayors present. It set forth that whereas a number of cities are interested in the purity of their water supplies, etc., etc., therefore be it resolved that Surgeon General Rupert Blue of the United States Public Health Service be requested to investigate the many systems of sewage purification—it may have read "sewerage" purification—and, as a result of this investigation, recommend the best system to use. This was the purport of the text; the exact words are not available, and it was not only signed, but advocated on the floor, by several of the distinguished heads of cities. This is not a joke, but a veritable occurrence. Engineers who are inclined to laugh at it should rather bestir themselves in their towns. Dissemination of the facts underlying great engineering operations or principles is apparently needed in many quarters.

No Military Control of Public Works

ALTHOUGH lost sight of in the confusion of the last days of the 65th Congress, the idea of a Federal Department of Public Works must not be allowed to die. Now is the accepted time for this most necessary change in the control of Government engineering operations, when Congress, through repeated appropriations, is alive to the extent of those operations, and, what is more important, to their divided control. Individuals must urge the Public Works Department idea; engineering societies must push it, but everyone should insist on a subordination of the military in this civilian department. Particularly will it be necessary to combat the idea that engineer officers of the Army must take charge of civil engineering works of the Government in order to provide them with the practical engineering experience necessary in war.

Granted that the Army's own work—barracks, fortifications, etc.—will not be sufficient to ground the Army engineer in the fundamentals of the construction and administration end of his profession, there is no reason why the engineer officer cannot be *assigned* to the civilian operations under the direction of a Department of Public Works, as has been done for many years in the British colonies. Let the Army engineer spend the proper amount of time in the Army organization—commanding men, studying and developing purely military engineering, building the structures and equipment necessary to the Army itself—and every so often let each officer be detached from his unit and assigned, as a civilian, with only a civilian's privileges and rights, to one of the multitude of engineering constructions that a proper Federal Department of Public Works would control. He could not thus carry over the asperity sometimes peculiar to the military uniform. That uniform would not bar the way of his subordinates to promotion. He would be, for the time being, a civil engineer in a civilian organization, learning many things of value to him in his profession of military engineer, and giving to the Government and to the job the benefit of his education and his experience.

A most powerful influence to bring about such a development will be found in the thousands of discharged soldiers. The Army, to these men, while a most necessary thing to have ready for war, demands a routine and a régime not at all fitted for the less rigorous operations of peace. They will insist, especially the engineers among them, that the Army stick to its military functions and leave Government civil construction to the less rigid and more democratic control of a peacetime civilian organization.

Plan to Eliminate Jurisdictional Strikes

EMPLOYERS and employed have taken an important step toward cementing the building trades into a league for the settlement of disputes as to union jurisdiction over work. The immediate purpose of the league, or board, as it is called, is to create a means for preventing strikes of building trades unions due to jurisdictional arguments.

Some months ago, at the separate but simultaneous instance of the American Institute of Architects and the Building Trades Department of the American Federation of Labor, the United States Department of Labor undertook to canvass the situation and suggest a working plan. After various conferences with labor leaders and representatives of the American Institute of Architects, a formal plan was drafted by John A. Lennon, and on Mar. 3 and 4, at Cleveland, Ohio, this plan was submitted for action to representatives of the building industry.

The plan submitted called for the creation of a body to be known as the National Board of Jurisdictional Awards of the Building Industry, to consist of eight members and eight alternates, four to be selected by the Building Trades of the National Federation of Labor and one each by the American Institute of Architects, the American Society of Civil Engineers, the Associated General Contractors of America and the National Association of Builders' Exchanges. The duties of the board are to hear and determine claims for jurisdiction over work performed, and make award in conformity with the facts. A three-fourths majority vote of the full board is required to fix the award, and it is provided that all local arbitration committees shall insert in the agreement between employers and employees a clause as follows: "The decisions of the National Board of Jurisdictional Awards of the Building Industry shall be final and binding upon the parties to this agreement."

Engineers, contractors and union labor have thus demonstrated their capacity for coöperative action for mutual benefit. This is an attainment which looks far beyond the immediate object sought. It promises, ultimately, a real partnership of management and labor in the construction industry.

Will Prices Fall?

WILL PRICES FALL, is the national question of the day. Upon its answer depends to a large extent the business activity of the near future, and upon that business activity in turn depend social questions of tremendous import. From time to time *Engineering News-Record* has commented upon the situation, the sum total of that comment being that prices are not likely to fall to any material extent in the near future. This conclusion has been predicated upon the belief that the total of the peace-time demand will not be far short of the war demand itself. During the war there was produced a tremendous shortage in practically every kind of commodity. There is an oversupply here and there, but the instances are isolated and entirely out of harmony with the general situation. That shortage must inevitably be overcome unless the peoples of this world lower materially their standards of living. History and the disposition of the public in every country of the globe give us the assurance that living standards will not be lowered. In fact, they are quite likely to be raised, still further increasing the post-war demand and assuring that it will be not much below that of the maximum war demand itself.

Reinforcing this point of view is the testimony of the periods following the Napoleonic and Civil Wars, graphed and discussed by Morris Knowles in *Engineering News-Record* of Feb. 27, 1919, p. 414.

Now Irving Fisher, professor of political economy in Yale University, approaching the problem from an entirely different standpoint, draws the same conclusion.

He takes the position that the world has advanced to a new price level, and that this new price level is no more likely to be receded from than were the price levels brought about by the great influx of gold and silver into Europe from the mines of the new world in the sixteenth century, or that caused between 1896 and 1914 by the discovery of the gold fields of South Africa, Cripple Creek and Alaska, the invention of the cyanide process in mining, and the vast extension in the use of bank credits. In other words, he sees in the present price advance, even though brought about by the urgency of war, a permanent change in the plane on which the world must do business.

Explaining his position, Professor Fisher adverts to the well known and thoroughly established fact that the general level of prices is dependent upon the volume and rapidity of turnover of the circulating medium in relation to the business to be transacted thereby. As he puts it, "If the number of dollars circulated by cash and by check double, while the number of goods and services exchanged thereby remains constant, prices will about double. Over $1,000,000,000 in gold has come into this country from abroad since 1914, and a large amount has disappeared from domestic circulation. On June 30, 1918, the portion of the gold reserve of the Federal Reserve banking system which supported national bank deposits and Federal Reserve notes was more than three times as large as the gold reserve under the old national banking system on June 30, 1914—$1,786,000,000, as compared with $592,000,000. During the same period, credit instruments (demand deposits and notes) increased about twofold—from $6,100,000,000 to $11,700,000,000. It is this increase of credit instruments, typical of the banking situation for the country as a whole, which, Professor Fisher points out, largely explains the present high level of prices.

Moreover, we are not at the end of the possible limit of expansion even now, provided we take the same view of our financial structure, or at least of the ratio between credit and gold, as we did in the pre-war period. At the present time the ratio of gold to credit has risen from 9.6% to 15.3%, while the reserve requirements of the present system are such that for 1918 there was an excess of gold above legal requirements of more than $700,000,000. The reserve required by law to support the $11,700,000,000 of credit instruments of 1918 is $1,070,000,000. The $700,000,000 of free gold could support an additional superstructure 70% as large as the existing one, which indicates that for the banking of the country as a whole a potential future expansion of 50% is a conservative estimate.

Discussing the situation from the standpoint of so-called "inflation," Professor Fisher points out that by inflation we mean merely the use of more circulating medium than is needed to transact the business of the country on a given price level. Whether or not we have inflation, therefore, depends upon the price level. If the price level of 1913-14 be considered normal, there would certainly be inflation now, but our currency is not inflated at the present time relative to the new level of prices in the world which the war has brought about. In other words, any expectation that there will shortly be a disappearance of this so-called "inflation" is based on the assumption that normal prices are those of 1914.

Looking to the future, there is no hope in sight for credit contraction; another large Government bond flotation is at hand, with the possibility of still another. After that there should be some contraction in the volume of credit, but Liberty and Victory bonds then in the hands of the people will be unrivaled bases of credit, and, experience shows, will undoubtedly be used for that purpose, thus tending to keep up the outstanding credit volume. He does not contend that it is absolutely impossible to bring down the price level, but argues that the experience of history and the possibilities now open for world-wide expansion point to the maintenance of present prices permanently or at least for a long period of years. Between the period of temporary and of permanent effects there may be a slight dip in the price level, say a year from now, but the possibility of that, he holds, is all the more reason why business should proceed now and not wait a year for the dip.

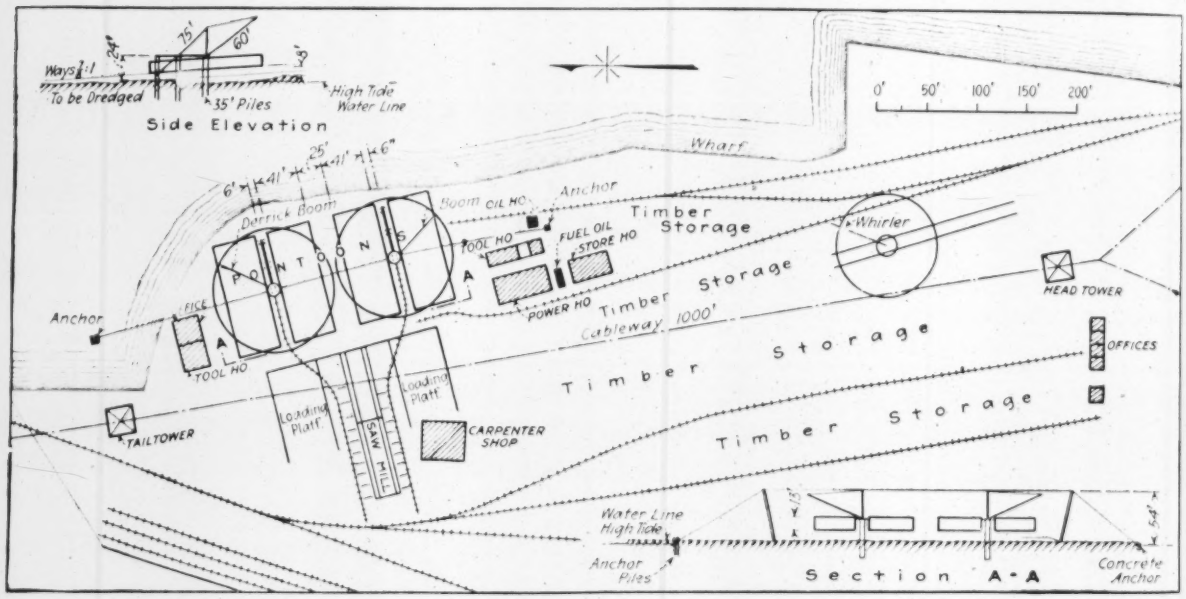
The conclusion to be drawn from this situation is that the sooner the business men of the country take the view that we are on a permanently higher price level and adjust themselves to it, the sooner will we save ourselves and the nation from the misfortunes that will come if we persist in our present false hope of expecting prices to come down, meanwhile creating a dangerous unemployment situation. Since the armistice, the buyers of the country have made an unexampled attack upon prices through their waiting attitude, and yet price recessions have been insignificant.

The clever man, Professor Fisher concludes, "is not the man who waits, but the one who finds out the new price facts and acts accordingly." What applies to the business man applies to Government officials, local, state and national, who hold a greater responsibility just now than the individual business man, for in their keeping rests national stability. If they will proceed with public works, the mills and the mines will operate, the whole industrial fabric will be strengthened, and the ominous prospects of business depression will disappear.

Building a Floating Dry Dock in Well Laid Out Yard

Cableway Assisted by Whirler and Derrick Car Keeps Heavy Timbers Ready for Carpenter Crews—Large Band Saws and Cutoffs Frame 12 x 12's Handled on Two-Way Roller System

MATERIAL for the 10,000-ton floating dry dock now under construction at Galveston, Tex., for the Galveston Dry Dock and Construction Co., moves through the yard with order and precision. To this fact and to the layout of the yard which permits this ready hauling of material, is attributed much of the speed and efficiency with which the work is being forming the heart of the material transportation system on the job. At one end of the yard a whirler derrick on a 12-ft. track was set up between the cableway and the railway siding, and is used to unload material directly to skids under the cableway. The sawmill was placed at the other end of the lot between the other track and the cableway at a point opposite the four



LAYOUT OF YARD WHERE FLOATING DRY DOCK IS BEING BUILT AT GALVESTON

carried out. The dry dock consists of 11 wooden pontoons each 41 x 110 ft. in plan and 13 ft. high which are built on four parallel ways and launched endwise, to be tied together afterward by the plate-covered steel frames which form the dry-dock wings.

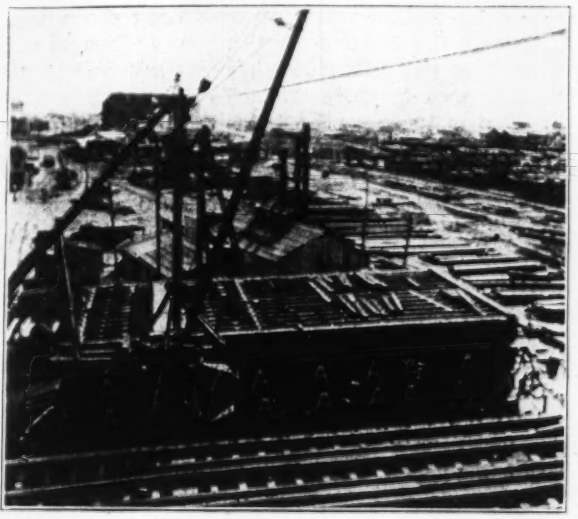
The ground selected for the construction of the pontoons, as shown in the drawing, afforded two railroad connections and a wharf. A cableway was laid out along the length of the lot between the railway tracks, ways. A derrick car unloaded onto the storage skids and platforms near the mill that part of the material which required framing. Other material was unloaded at the other end of the yard directly under the cableway. The storage piles were so laid out that the longest timbers required could pass between them while going from the mill to the derricks on the standard-gage four-wheel cars of the feeder tracks. Each track fed one derrick. As the tracks passed under the cable-

PANORAMA FROM CABLEWAY TOWER AT END OF YARD USED FOR BUILDING PONTOON UNITS FOR A FLOATING DRY DOCK FOR GALVESTON, DRY DOCK AND CONSTRUCTION COMPANY

way the cars also received material for the derricks from the cableway.

The mill itself is composed of two units, although under one roof, run by one engine and fed by a derrick car and cableway. Each unit consisted of a 36-in. band saw and a cutoff, one 36 and the other 42 in., and a roller conveying system from the storage piles. One joiner and one rip-saw served both sides, and one engine drove the two lines of shafting which took care of all equipment. Each side of the mill supplied the derrick nearest it.

Large saws were used, as the timber to be cut was all of large dimensions. The swinging cutoffs were found very useful in squaring ends and cutting lengths, while the band-saws were used for bevel work where the weight of the piece to be cut would permit maneuvering at all readily. Extremely heavy pieces were cut with a pit-saw by hand. A box templet was used to

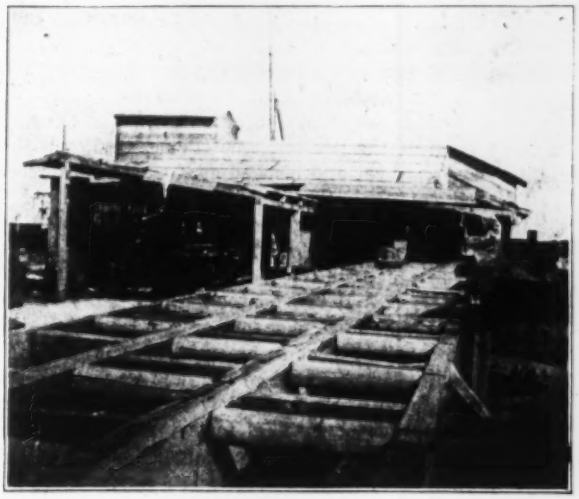


THIS DERRICK WAS ABLE TO BUILD TWO PONTOONS SIMULTANEOUSLY, EACH 41 x 110 FEET

get a true cut, and the timber was placed on a platform to eliminate the necessity of a pit.

The platforms adjoining the mill were built of timbers bought for the pontoons and used in them at the end of the work. As pieces requiring but little framing were selected, there was little mill work left to be done after the platforms were torn up. The ground blocks and the struts which sat on them were the only timbers bought for the platforms.

To facilitate easy handling, the tops of the mill platforms, skids and rollerways were made level with the tops of the saw tables. Rollerways on both sides, running close to the cutoff, led from the end of the platform by the switch to the end of the pontoon ways. On the switch side two more rollerways were placed beside the one toward the center of the mill. Outside were 8-ft. horses built with cast-iron rollers projecting from their tops, for the purpose of conveying timbers in a direction across the length of the piece. These rollers overlapped each other in plan, so that an 8-in. piece would always be on two of them and not edge between the rollers and the stick. The idea of these rollers was obtained from work of the Midland Bridge Co. in Houston.

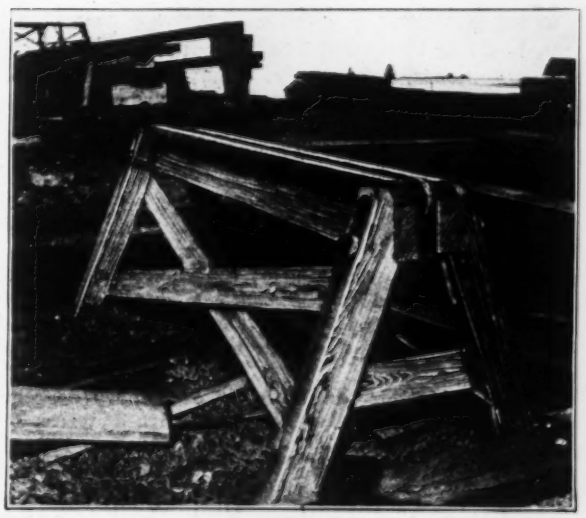


ROLLERS THAT HANDLE HEAVY TIMBER AT SAWMILL

Timber was stored in a long pile under the cableway and in several piles around the mill. The cableway pile held the material for six pontoons when piled to a height of nine feet.

The skids away from the mill were only built high enough to keep the timber off the ground and to allow a chain to be passed readily underneath.

Another point that made for smooth, quick work was the fact that the derricks at the ways were raised high above the pontoons. The engine runners could see directly and at close hand the placing of almost every piece they handled. Free motion of the boom is afforded by this elevation, as well as by the use of a single stiffleg and an overhead guy. One cable runs over the top of the two derricks and on over two masts, one at each end, placed clear outside of the area occupied by the pontoons. The ends of this cable are anchored after passing these outside masts. The stiffleg on each derrick secures the mast in two directions, and the guy

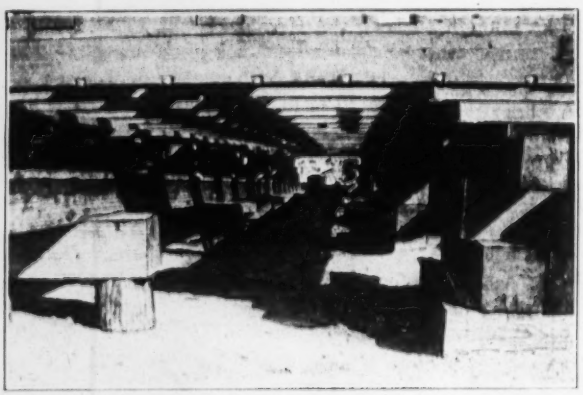


A HEAVY TIMBER LAID ON SEVERAL OF THESE ROLLER HORSES PLACED SIDE BY SIDE IS EASILY MOVED

over the top holds it in the two opposite directions, thus securing the derrick.

Support of the pontoons during construction was provided at the ways by piles of blocking topped by 8 x 12-in. wedges, as shown in one view. The flooring on the bottom of the pontoon was then placed, and the sliding ways were set and blocked against the bottom of the finished pontoon. The fixed ways were built of 9 x 9-in. timbers bolted together to form a 9 x 18-in. piece with staggered joints. This was laid flat on the supporting pile caps. With the blocking snugly set between the ways and the pontoon, the weight of the latter was delivered to the former by loosening the wedges on top of the blocking upon which the pontoons had been built. In one or two cases it was necessary to dig under these blocks and allow them to settle, but usually the wedges themselves moved readily enough. The upper or sliding ways were flanged instead of the lower or fixed ones, which required less flange material, as the upper ways were the shorter.

After it was launched, but before it was towed to the assembly slip, each pontoon was loaded with steel for the wings. These wings are water-tight steel walls which are continuous over the several pontoons, and so assemble them into a unit, the finished dry dock. A joint is made in the wings, however, so that the 10,000-



DETAIL OF BLOCKING AND WAYS

ton dock may be divided into two units, using four and seven pontoons, respectively. The framework of the wings is erected by a derrick barge which also handled the outside plates. The inside plates are raised by a hoisting engine using a line through a block fastened to the top of the framework. A permanent compressor plant was outfitted early so as to supply air for driving the 300,000 rivets used in the wings.

In order to hold the pontoons firmly in the correct position during the placing of the wings, four wooden trusses are bolted to the pontoons, holding the two pontoons being attached to those already assembled. When new pontoons are to be attached the trusses are moved ahead.

The construction and assembly of the dry dock are being done by a Missouri Valley Bridge and Iron Co. organization headed by F. E. Washburn as engineer in charge. C. W. Cubbage is superintendent on the work in the pontoon-building yard, and F. L. Brock is superintendent of steel erection. H. A. Treat is general manager of the Galveston Dry Dock and Construction Co. The dry-dock design, including assembly trusses, was made by William T. Donnelly, of New York.

Army Trade Skill Tests Applicable in Construction

Half an Hour Tells Whether Workman is Expert, or Merely Skilled, or Is a Novice— Clerks Can Conduct Tests

BY SIMPLE oral, picture and performance tests any contractor or works manager can determine whether a workman seeking employment is an expert, or is merely skilled, or is only a novice in his trade. This is the conclusion which may be drawn from the experience obtained in classifying the men of our new National Army, stated Col. Walter Dill Scott in an address before the Chicago Chamber of Commerce, Feb. 12, 1919.

Half of the men in a modern army must be skilled at special trades in order to perform their duties. The new Army had, of course, to avail itself of the trade knowledge and experience which recruits brought with them from civil life, since time was not available for training men in trade skill. To discover this talent and assign it where needed was the task of the Army personnel organization, in which Colonel Scott served.

Until Nov. 11, 1918, when the armistice went into effect, 250,000 men who had professed trade skill had received special trade tests. There had at that time been standardized 71 oral, 12 picture and 19 performance trade tests, and 42 additional picture tests and six additional performance tests were in preparation. Some of these main tests were subdivided, so that in reality the count was greater than the figures given indicate. For example, there was a test for carpenters and an extension of this test for ship carpenters. A single test, or any two tests, or all three tests were employed, depending upon the man or upon the trade.

Oral tests consisted of a series of weighted questions. If the applicant's answers counted less than 15 points he was graded among the novices; if they counted from 16 to 31 points he was graded among the apprentices; if they counted from 32 to 55 points he was graded as a journeyman; and if they counted over 55 points he was graded among the experts. Every question was written and had to be put as written; it could be repeated, but its wording could not be changed in the repetition. Thus the test could be conducted by any intelligent clerk, after a little training.

Performance tests were equally simple. If a carpenter, for example, the man received a rough-sawed 2 x 4 in. timber, say 2 ft. long, to fashion according to a blueprint plan. This print called for one end to be beveled, a dove-tail mortise to be cut in the opposite end, all four sides to be dressed, etc., all to the exact dimensions shown. All the tools necessary for the work were provided, and a time was set for completing the job. At the end of the period set, the work was examined, and by its approach toward completion and its quality and exactness the man was rated as an expert, a journeyman or an apprentice in skill, or merely as a novice. In the same way a blacksmith was required to make to blueprint a simple eyehook, using two pieces of metal so that his skill in welding would appear. As in the case of the carpenter, all needed tools were provided and a time limit was set.

Picture tests were intended to show the man's knowledge of the tools of his trade. If he were a horseshoer a large card on which were pictured ten or a dozen numbered tools and articles commonly used in horse-shoeing was shown him. He was asked to name No. 1, No. 2, and so on and was marked on the accuracy and precision of his designation of the tools and articles. Precision of definition was held important. For example, if picture No. 5 showed clinch tongs, it was reasoned that anyone could answer "tongs," but only a man who knew about horseshoeing would answer "clinch tongs."

An average of about 30 min. per man was required to make the tests. To determine how and where to place the men, job analyses were made. These gave for each department of the Army the number and kind of skilled men needed, and designated the degree of expertness required for each position. The task of fitting the man to the position was then comparatively certain.

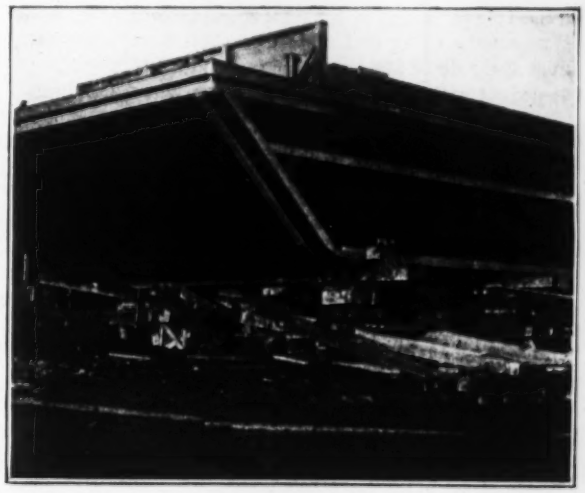
Trade tests only have been mentioned; as a matter of fact, classification by similar methods was made of 3,365,000 enlisted men and 194,000 commissioned officers. When the war stopped, stated Colonel Scott, "the work was well under way, and in another year we should have had a real army in which we would have known the capacities of the men and the positions in which men of these capacities were needed. The process is equally applicable to any kind of business."

Side Launching a Concrete Lighter

After Concreting, Boat Is Lowered to Four Sliding Ways by Jacks and Is Launched by Releasing End Cables

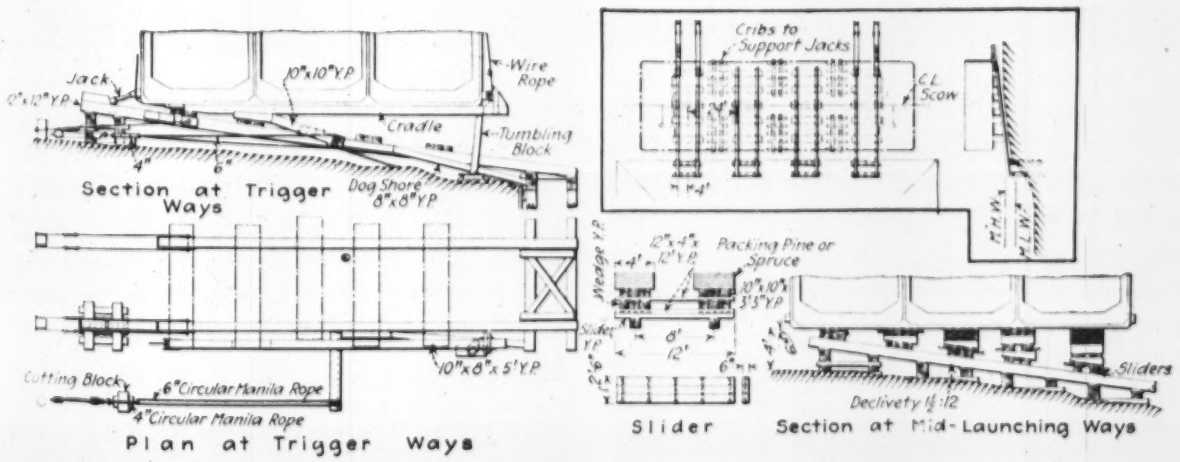
CONCRETE lighters 112 ft. long, 11½ ft. deep and of 34-ft. beam, weighing about 500 tons, have been launched sideways at the yard of the Aberthaw Construction Co., at Providence, R. I. The construction of the lighters was described in *Engineering News-Record* of Oct. 7, 1918, p. 704.

Four pairs of launching ways were placed under each lighter, the ways being built at mean high-water level, with the outer ends just awash at high tide, and the area immediately in front of the ways, 100 x 130 ft., was dredged out to a depth of 4 ft. The ways are set at an incline of 1½ in. in 12 in. and are built of 12 x 12-in. yellow pine, dressed smooth on the top and resting on sills laid in trenches, the outer end being supported on piling. Each pair of ways is 9 ft. wide, outside measurement, and the pairs are set at an interval of 24 ft. between centers. Across each pair of ways, under each longitudinal bulkhead and in the center of each water-tight compartment, was placed a yellow-pine slider which carried the wedges and blocking.



ONE END OF CONCRETE BARGE ABOUT TO BE LAUNCHED, SHOWING CRADLE AND TRIGGER

The outer unit of each pair of ways at either end of the lighter constituted the trigger way, being extended to the rear and capped with a piece of yellow pine to afford a bearing surface for the base of jacks which served to start the vessel on the ways. The trigger ways were reinforced by two 1-in. round steel



DETAILS OF LAUNCHING AND TRIGGER WAYS FOR SIDE LAUNCHING OF THE ABERTHAW CONCRETE BARGES

bars fitted with turnbuckles and running back to deadmen which also served to anchor the block and tackle which formed part of the releasing gear.

Under the lighter at either end was placed a cradle of 10 x 10-in. yellow pine fitted with an eye at one end and at the other a lip which set against the side of the barge, the shoe being held snugly against the bottom of the lighter by a ½-in. wire rope running up to the deck. On the under side of the shoe is a recess to take a strut running down to the trigger bar, which was a piece of 10 x 10-in. oak; the outer end of this was fastened to a deadman by a manila rope 6 in. in circumference, doubled and made taut by means of a block and tackle attached to the deadman in the rear of the launching way. The block is connected to the 6-in. cable by a double strand of 4-in. manila rope passing over the cutting block. From the outer side of the trigger a dog shore, 8 x 8 in., butted against the piling on the outer end of the launching way. Directly under the side of the barge was placed a tumbling block, beveled at either end; this fell clear when the lighter started down the ways.

When the concreting had been completed the barge was jacked up on building movers' jacks, carried on railroad ties on either side of each launching way, and the formwork was removed. The barge then was lowered to the blocking on the sliding ways. From this point, the barge was kept in place on the ways by the cradle shown, the strain being taken by the manila cables attached to the trigger bars.

A few turns on the jacks served to loosen the ship on the sliding ways, and, the signal being given, the releasing gear was severed simultaneously at the two cutting blocks. The resistance of the vessel striking the water broadside was sufficient to arrest the momentum, no rope stops being necessary.

Chloramine Tried by New York City

THE application of the chloramine process to the somewhat polluted water of Esopus Creek before it goes into the Ashokan reservoir at the head of the Catskill Aqueduct was described at the February meeting of the New York Section of the American Water-Works Association by Dr. Frank E. Hale, director of laboratories of the Department of Water Supply, New York City.

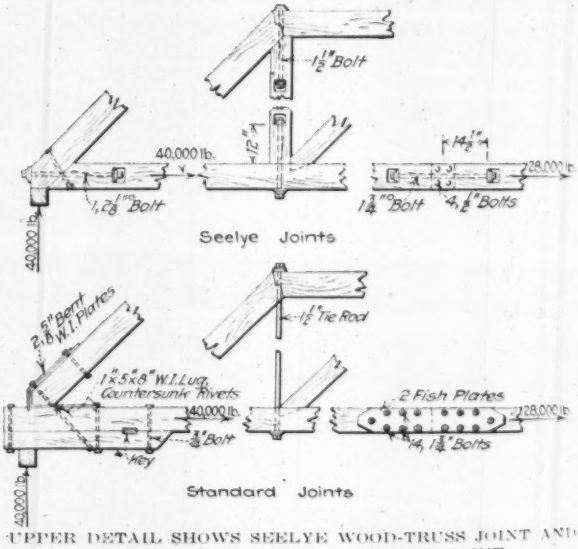
Although the water from the Ashokan reservoir has a long period of storage and is subjected to treatment with liquid chlorine before it reaches New York City, chlorination of the water of Esopus Creek before it reaches the reservoir was considered desirable. This was decided on in 1917 as soon as control of the Catskill watershed was taken over by the department. Local conditions prevailing at that time led to the adoption of hypochlorite instead of liquid chlorine for the Esopus Creek water. Immediately upon introduction of the hypochlorite (0.4 ppm.) complaints were received that the water was killing trout in the creek. This led to trial of the chloramine process (ammonia used with the hypochlorite), in an attempt to reduce the amount of chlorine and sludge. A material reduction in the unit rate of free chlorine applied (from 0.4 to 0.1 ppm.) was found to be possible, with good bacterial results and elimination of the fish problem, but the comparison of results obtained throughout more than a year's study indicated that equally good results were obtained by the use of hypochlorite alone. For example, the total bacteria and the B. coli removal with application of 0.05 ppm. available chlorine, bleach compared with chloramine, was, respectively, for bacteria 71% and 74%, and for B. coli 98% and 96%. These results indicated that the cost per unit of available chlorine applied for chloramine was double that of hypochlorite alone, since the ammonia cost four times as much as the hypochlorite, and the relative amounts of each applied were in the inverse ratio of one to four. This ratio was indicated by the experiments to be the correct ratio, the formation of chloramine being shown by a decidedly larger amount of free chlorine in the treated water than when bleach alone was used.

An important point brought out in the paper was that a given amount of available chlorine applied, and found by analysis to be actually in the water, did the same work—that is, percentage removal of bacteria and of B. coli—*at all temperatures*, winter or summer, from 32° F. to 76° F. Another point to be emphasized is that very small amounts of available chlorine may be effective in waters of low mineral and organic content.

The paper and discussion following brought out the fact that chloramine cannot safely be used except where there is very strict laboratory control, since otherwise the hypochlorite and the ammonia are likely to result in a variety of reactions and compounds, depending chiefly upon the proportion of chemicals applied and the strength of the solutions.

New Tension Joint for Wood Truss

BY APPLYING a type of tension joint common to certain kinds of cabinet work to wood trusses, Elwyn E. Seelye, consulting engineer, New York City, has made possible the framing of a truss in wood without the use of special plates, beveled washers, long



UPPER DETAIL SHOWS SEELYE WOOD-TRUSS JOINT AND LOWER SHOWS TYPICAL FRAMED JOINT

bolts, keys or complicated mortices. The joint, shown in the upper part of the cut, consists of a central bolt seated against the sides of through holes in the truss members. Comparison with the usual type of truss framing is made in the two drawings.

Fabricated Ship Construction at Bristol Yard

Plant and Operating System Closer to Precedent Than Those of Other Agency Yards—Reinforced-Concrete Shipways Flush with Ground—Tower Jib Cranes Traveling On Trestles—Pre-Assembly Practice

FABRICATED-SHIP construction at the Bristol yard of the Merchant Shipbuilding Corporation involves fabricating about 17% of the hull material in the yard shop. The working system, therefore, differs radically from that of Hog Island and Newark Bay, the two other original agency yards of the Emergency Fleet Corporation. Of these two, the former was planned for 100% and the latter for about 95% bridge-shop fabrication, as compared with the 83% of Bristol. In the planning of the Merchant yard this condition exerted a controlling influence, and led to close coordination of shop and berths. In this as well as in most other points of layout, shipyard precedent was largely adhered to. Furthermore, the derricks which at the other fabricating yards recall the bridge erector are not found at Bristol; in their place, traveling tower derricks are provided for the ship-erection service.

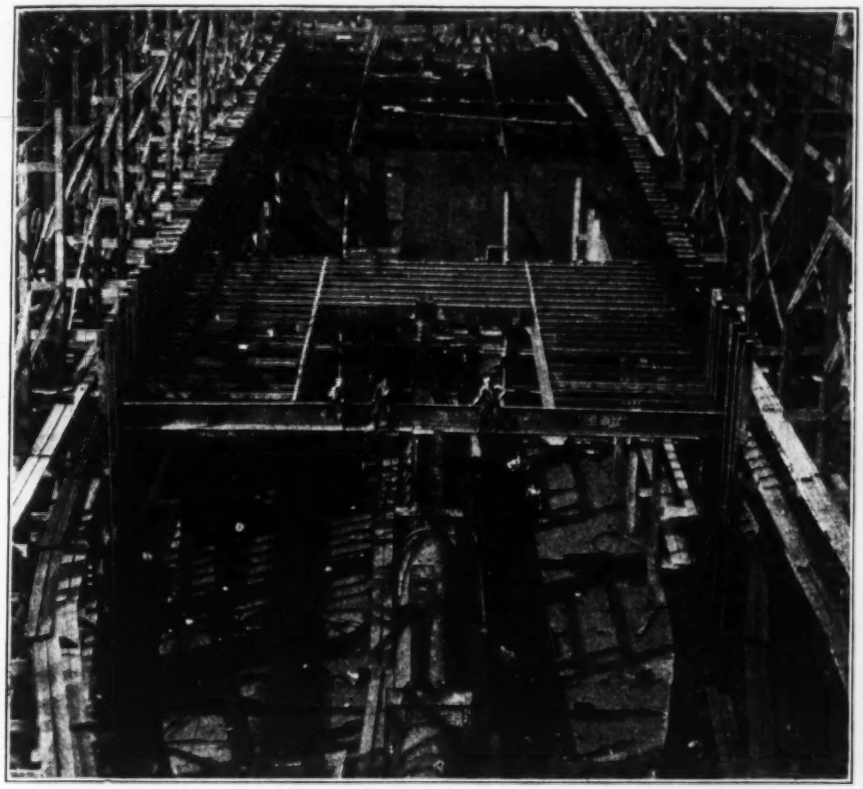


FIG. 1. MATERIAL FROM WAY-HEAD TRACK IS PLACED BY TOWER CRANES—PARALLEL MIDDLE BODY MAKES FABRICATION EASY

Included in the work fabricated in the shipyard punch shop are the following main items: All furnaced plates (in ends of shell as well as in keel and at knuckle), all bent frames, bottom angles on floor frames in forward and after sections, margin angles and web frames outside of the parallel body, frames and floors in peak, deck stringer angles at ends, ventilators and miscellaneous material. The work involved is estimated to cover about 40% of the total fabrication work required for the ship. The division was based on the desire to allot to the bridge shops only that work which they could do most economically with their existing equipment. Accordingly, of the bridge-shop material about 90% is either multiple-punched or rack-punched, and only about 10% single-punched.

To facilitate the outside fabrication as much as possible, the Merchant designers developed a transverse section of the 9000-ton ship which was to be built showing typical transverse rivet spacing, from which the shop men could set up their multiple punches direct. Pole templets for the longitudinal spacing of the multiple-punch rack could also be made from a drawing direct. The Merchant shop made templets only for the ends of the ship where the plates could not be multiple-punched; for this work it furnished the bridge company with one set of templets, which were then copied at the bridge shop to provide templets for the various plants at which the steel was to be fabricated. Rolled plates for the molded ends of the ship are punched at the bridge shop but are not rolled, so that they can be shipped flat; the rolling is done in the yard shop. Convenience in shipping also dictated the limit to which pre-assembly of parts at the bridge shops was carried. It is stated by officials that except for shipping reasons it would be possible to do approximately twice as much riveting in the bridge shop. According to the contract division of the work, the bridge shops drive about 100,000 rivets out of a total of 625,000 in the hull.

The general scheme indicated by the preceding was worked out for executing an order of the Emergency Fleet Corporation to build 40 steel cargo ships of about 9000 tons dead-weight carrying capacity. This order was subsequently increased to 60 ships of the same size. The contract time for completion of the order is about two years from September, 1917, when the contract was executed. Twelve shipways were laid out to carry this program through.

Character of Ship Design—Simplification of the design of the ship to adapt it to bridge-shop fabrication was not carried so far by the Merchant Shipbuilding Corporation as by the two other agency yards which

began work at the same time. The vessel is of the ordinary transverse-framed type with frames spaced generally 27 in. The bottom has a small amount of dead rise; the sides are vertical to the upper deck, but the bridge sides have 6-in. tumble-home. For easier fabrication, the parallel middle body was made very long, 50% of the length of the vessel, and the full decks were made flat (without sheer), sheer being given only to the forecastle and poop deck and the bulwarks. Transversely, the second deck has no camber, while the upper deck and the decks above have a straight pitch of 13½ in. to the center line amidships. The floors are, in general, alternately solid and bracket floors, the latter made of 7-in. channel frames with brackets at the center line and at the margin plate. The margin of the tank stop is turned down normal to the shell, and the floors here have no bent parts.

Shipbuilding Plant Compactly Grouped—In the layout of the shipyard, which was briefly sketched in advance of construction in *Engineering News-Record* of Jan. 3, 1918, p. 12, the important rôle assigned to the yard shop finds expression in unusually close grouping of the berths, and of shop and berths. The principal character of the layout, Fig. 2, was determined by certain local conditions, skilfully utilized by the designers to secure economy of construction.

A manufacturing plant, the works of the Standard Cast-Iron Pipe and Foundry Co., stood on the site, and two of the main foundry buildings of the plant were adaptable for use as the fabricating shop of the shipyard. These were long, narrow buildings standing end to end in a line parallel to the river bank and about 400 ft. back of the water; by a short connection between their adjoining ends they could be transformed into a

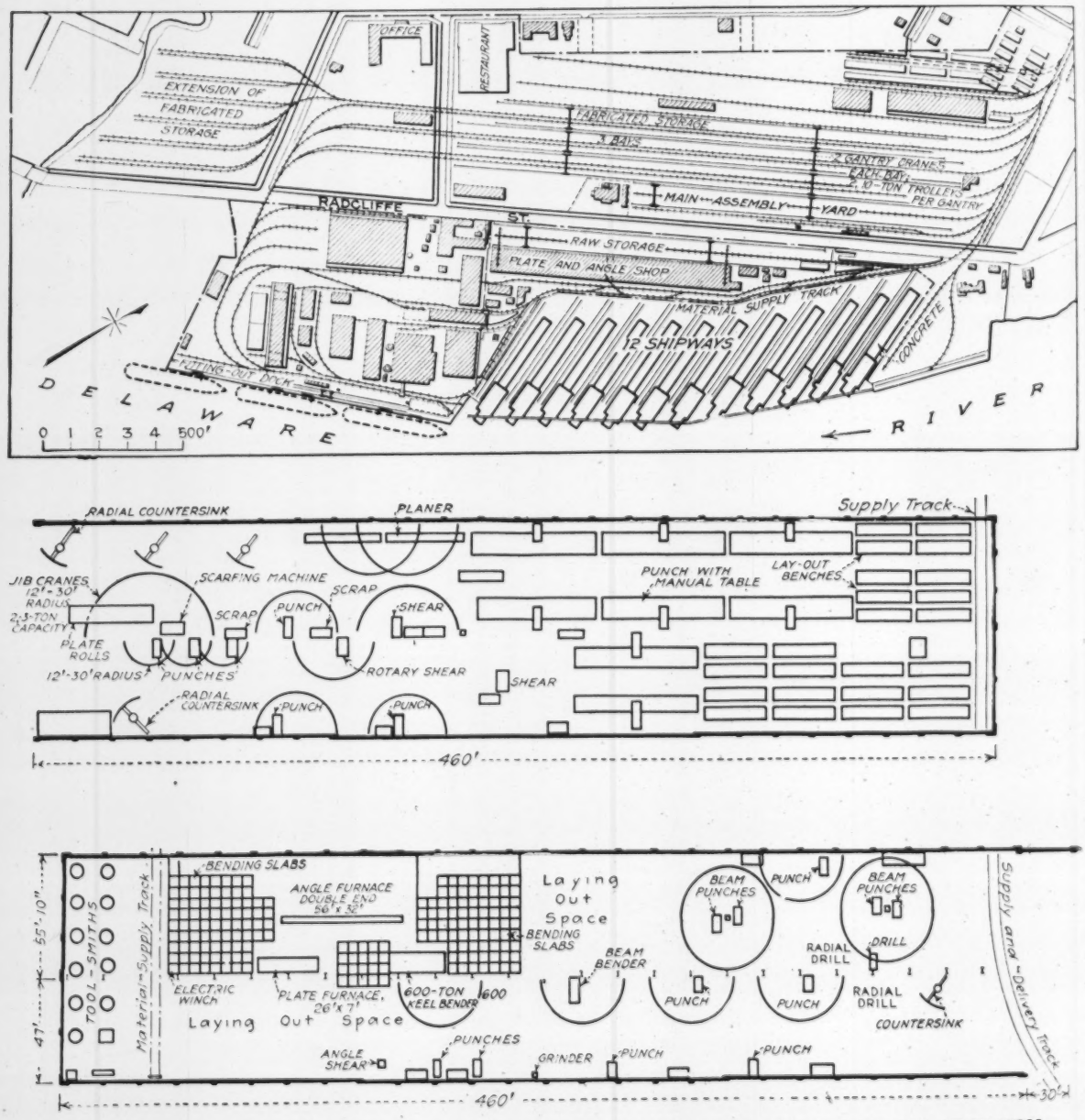


FIG. 2. GENERAL PLAN OF FABRICATED SHIPYARD AND LAYOUT OF PLATE-AND-ANGLE SHOP AT BRISTOL MERCHANT SHIPBUILDING CORPORATION, AGENT FOR EMERGENCY FLEET CORPORATION

single shop building 99 x 970 ft., giving ample space for the required fabricating capacity.

Because of these conditions, permanence of construction was made an objective in the design, at the same time with economy. Since the plant was built at the cost of the Emergency Fleet Corporation, only such expenditures were warranted as were necessary to create a shipbuilding plant of the desired capacity in the shortest possible time. However, as the site gave ideal opportunity for the construction of concrete ways, and the development of the necessary shop buildings was facilitated by the existing buildings of the pipe foundry, a shipyard of permanent character resulted quite naturally. According to the officials of the company, the concrete slab ways have proved entirely successful during the year of operation since shipbuilding started, early in the spring of 1918. There has been no settlement or other injury, and the construction has met all other service requirements.

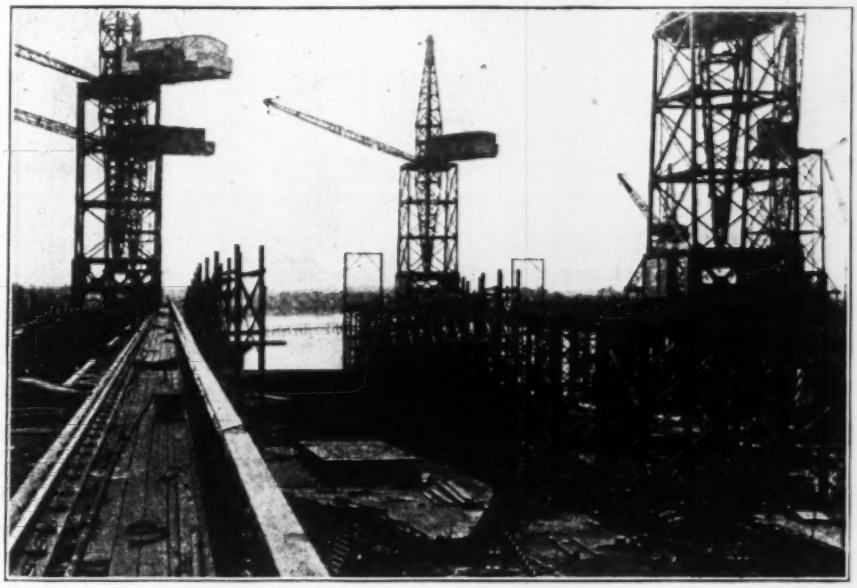


FIG. 3. SHIPBUILDING CRANES AT BRISTOL TRAVEL ON TRESTLES

In design the ways are composite (Fig. 4), consisting in part of concrete slabs 4 ft. thick by 38 ft. wide, and in part of reinforced-concrete beams supported by concrete piles. This is the typical construction above high-water mark. Below high water the ways are timber—wood piles with transverse wooden caps accommodating not only the keel blocks and the launching-way stringers but also abutments for the lateral shores of the standing ways. The sloping ground of the bank required but little grading to adjust it to the launching slope, and the ways were therefore constructed flush with the graded ground surface.

On account of the limited space between the shop building and the river, it was necessary to set the ways at an angle to the shore line in order to accommodate the 400-ft. ship length and have room for tracks and way-head storage space. This skew arrangement proved advantageous in enabling the ship-erection cranes to reach the supply tracks better than would have been the case with ways set square to the shore. The combination of skew and ground slope resulted in a slightly stepped profile in section parallel to the shore, there being a step 2 ft. high from each way to its neighbor; this, however, does not affect the shipbuilding operations.

While most of the other fabricating yards adopted fixed derricks for their shipbuilding machines, Bristol chose traveling cranes; and, instead of having longitudinal supply tracks between the ways to distribute material along the length of the ship, it has tracks across the head of the ways only. From these tracks all material is handled down along the berths by cranes. Omitting tracks between the ways made it possible to group the shipbuilding berths very compactly, as the plan, Fig. 2, indicates.

For each shipway two shipbuilding cranes were provided, placed as may be seen in the view, Fig. 3. Revolving jib cranes (Fig. 5) of the type built by the Terry Manufacturing Co., of New York, which had already found use in several shipyards, were chosen as the most suitable for the present service. Nine ways are equipped with these cranes. They have 92-ft. booms, and can lift five tons at extreme reach and 15 tons at 54-ft. reach (hook at center line of ship). The three northerly ways, however, are equipped with locomotive cranes of turntable type, six of which were available for service earlier than the Terry cranes. These machines, of the Brown Hoisting Machinery Co.'s design, have 72-ft. booms and can lift 15 tons at about 40-ft. reach. To make the maximum lifting capacity available practically at center line of ship, the ways in question were spaced 86½ to 97 ft., instead of 108 ft., as are the others.

Trestle supports for the travelers were necessary to give a level track, and it was considered desirable that the cranes should travel on an elevated track for their entire length. The inshore end of the trestle, therefore, was made high enough to give clearance for trucking underneath the bracing. Trucking roads or passageways were at one time contemplated, but they were discarded in the final development of the plan. The space under the trestles is in part occupied by service buildings, and in part used for storage of material awaiting erection, though most such material is held in racks or piled at the head of the way.

On account of the angle between the supply tracks and the crane runway, all the cranes are able to take material from cars on the supply tracks. Furthermore, on all the ways except the one at the north end of the group, four cranes can be concentrated on one ship. According to the yard authorities, the crane equipment has proved to be ample in capacity for all requirements.

Storage Facilities—As material fabricated at the bridge shops could not reach the yard in such sequence in timing as to enable the berths to be supplied direct from incoming cars, storage was a vital feature, and

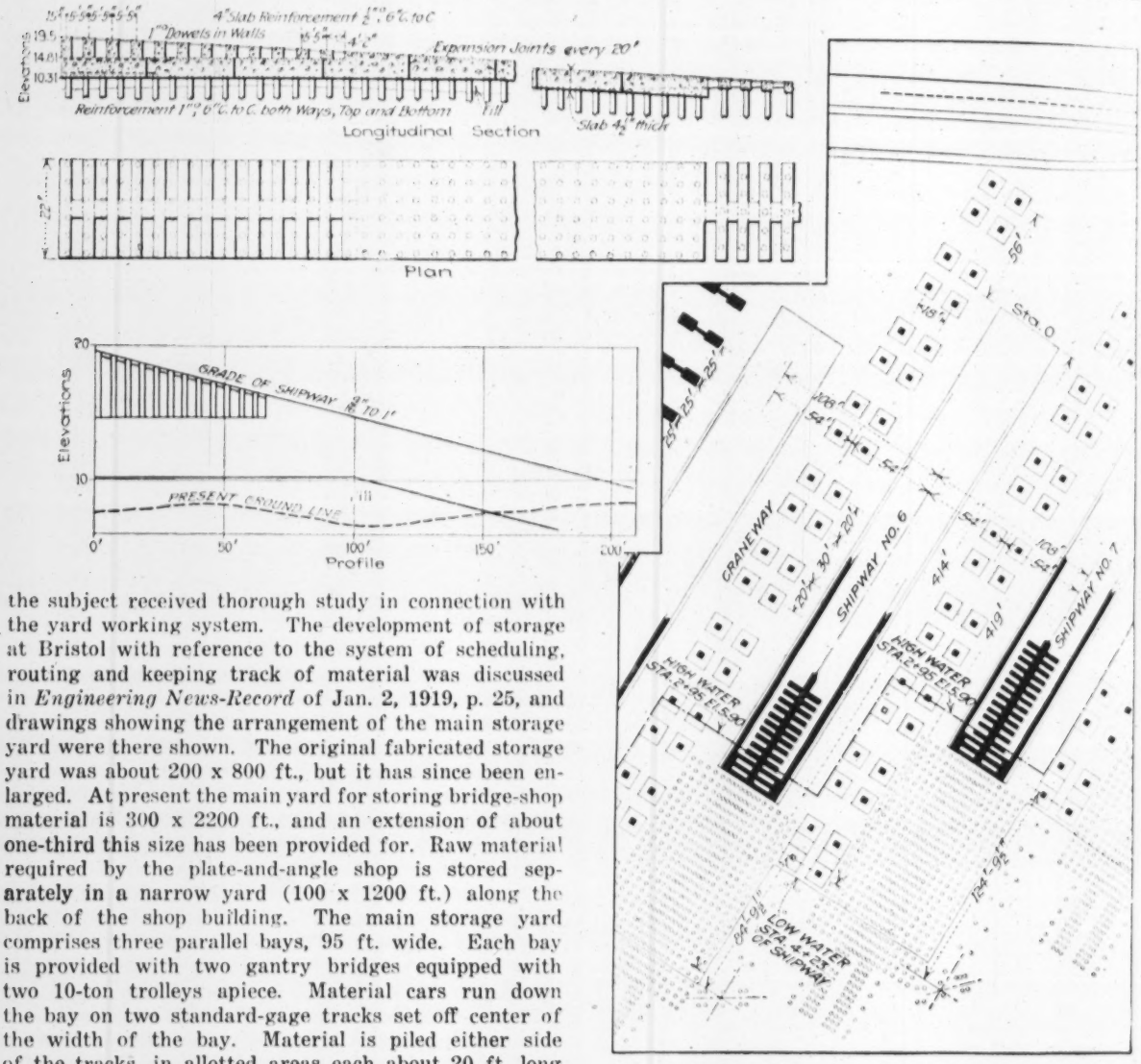


FIG. 4. REINFORCED-CONCRETE SLAB WAYS FLUSH WITH GROUND

the subject received thorough study in connection with the yard working system. The development of storage at Bristol with reference to the system of scheduling, routing and keeping track of material was discussed in *Engineering News-Record* of Jan. 2, 1919, p. 25, and drawings showing the arrangement of the main storage yard were there shown. The original fabricated storage yard was about 200 x 800 ft., but it has since been enlarged. At present the main yard for storing bridge-shop material is 300 x 2200 ft., and an extension of about one-third this size has been provided for. Raw material required by the plate-and-angle shop is stored separately in a narrow yard (100 x 1200 ft.) along the back of the shop building. The main storage yard comprises three parallel bays, 95 ft. wide. Each bay is provided with two gantry bridges equipped with two 10-ton trolleys apiece. Material cars run down the bay on two standard-gage tracks set off center of the width of the bay. Material is piled either side of the tracks, in allotted areas each about 20 ft. long in the direction of the tracks.

The storage yard is laid out with a definite space assigned to each piece in the ship. The problem of laying it out depended on the number of pieces rather than on the tonnage involved, the latter being simply a matter of higher piling.

In the operation of the plant the storage facilities are of central importance, because the whole system has been worked out to provide storage intermediate between shop and ship, and to avoid working direct from shop to ship in any department.

Shop-to-Storage-to-Ship System—Incoming cars of material fabricated at the outside bridge shops run directly into the main storage yard, and are there unloaded, and the material is placed in its allotted storage space by the gantry cranes. An essential piece of work at this point is painting the erection mark on each piece, the shop marks chosen by the bridge shops for their convenience being different from the ship erection marks. From storage, material is drawn on requisitions by any one shipway, according to the needs of the day.

Material fabricated in the yard shop is in part also worked through storage, in order to render the operation of the shop independent of the variations of the berth requirements. This material is of two kinds, templeted and lifted material. The latter, fabricated on special order from the shipway at the time when needed, does not go to storage. Templeted material, however, is worked ahead or on stock, and all this goes to the fabricated-storage yard just as does the incoming bridge-shop material. Similarly, such parts as are fabricated up to a certain point by the bridge shop and have finishing operations, such as rolling, bending or riveting, put on them by the yard shop, go from the fabricated-storage yard (where deposited when unloaded) to the yard shop, and then are returned to the storage yard to await call from the shipways.

Pre-Assembly Highly Developed—In carrying on the routine of minor assembly work, such as that on web frames, stringers, and other curved members, which, because of containing formed work, were not made or were only partly completed by the bridge shop, the Merchant yard during the year has been led to develop pre-assembly to a remarkable extent. An assembly yard 100 x 700 ft. was provided at the start, but it was

later increased to a length of 1300 ft. In addition, a space at the end of the plant north of the ways was available for assembly work.

Facilities for supplying and handling material and suitable tool equipment are features of the large assembly yard. This yard, at one end of the fabricated-storage yard, is spanned by a gantry like those of the storage yard, but has only one longitudinal track. Air-outlet manifolds are placed along the sides at about 20-ft. centers. For the smaller work, such as that on web frames and stringers, a shelter shed about 40 x 40 ft. is provided in the center of the bay, with two air-operated bull riveters. All other riveting is done by pneumatic hammers.

The larger parts that go through assembly, in its present development, are: All deck houses, shaft tunnels, bulkheads, the complete fantail with part of its plating, and the entire keelson with the flat keel riveted to it in lengths of 60 to 100 ft. The splices between these keel sections are ready reamed for final assembly on the keel-blocks. The bow section of the keel is assembled with attached frames. The heaviest members are the large bulkheads and deck houses, weighing 25 tons; these are handled by two cranes. They are assembled in the assembly space north of the raw-material yard, and when completed are loaded on cars by locomotive cranes and shifted along to points within reach of the berth cranes.

In this same assembly space the fitting up and assembling of the keel and keelson girder are carried on. The assembled keel is set up on horses for the full length of the ship, riveted complete in sections 60 to 100 ft. long, and the splices between sections are reamed ready for riveting on the keel-blocks.

This process is carried still further in the case of the bow section of the keel, where, for a length of 11 frames back of the stem, the lower pieces of the frames are riveted to the keelson girder in the assembly yard, thus making a single erection piece out of nearly 30 separate shop pieces.

A still further extension of pre-assembly is contemplated by the corporation. D. D. Smith, assistant general manager, says it is expected that ultimately something like 40% of the hull weight will be involved in the pre-assembly work. This will mean a largely increased amount of shop riveting.

Supply Racks at Head of Ways—Ship erection is carried on from a small way storage at the head of the way, and not from the supply cars direct. Steel plate-racks are provided here, with piling space alongside for floors, frames and similar members. The original intention was to stow all ship material under the crane trestles, but the way-head storage is found more convenient.

Engineering and Fitting Out—The southerly half of the yard area is developed for manufacturing and storage of engineering and ship equipment supplies and for the fitting-out work. Along the river front a timber wharf 1150 ft. long gives berthing space for three vessels engaged in outfitting. Traveling on a track laid on this dock is a large 60-ton luffing-jib crane capable of doing all the heavy hoisting work in placing boilers and machinery on the ship. This crane was described in *Engineering News-Record* of Nov. 21, 1918, p. 937. It is to be supplemented for lighter work by a quick-moving crane, on the same tracks. This will have 15 tons capacity at 54 ft., and 5 tons at 100-ft. radius.

In the case of the ships built at the Merchant yard up to the present, the boilers and turbines have been set in place before launching, and it is intended to continue this practice so long as the machinery supply keeps ahead of ship construction, though the fitting-out crane equipment is capable of setting all machinery at the fitting-out dock. The boilers of the Merchant ships are relatively light. If necessary to install Scotch boilers, however, they would have to be handled at the fitting-out dock. This was one reason for the 60-ton load capacity of the fitting-out crane.

The principal officials of the Merchant Shipbuilding Corporation are R. H. M. Robinson, president; W. T. Smith, vice-president; G. C. Thayer, general manager, and D. D. Smith, assistant general manager. H. E. Frick is the authorized representative at the plant for the Emergency Fleet Corporation.

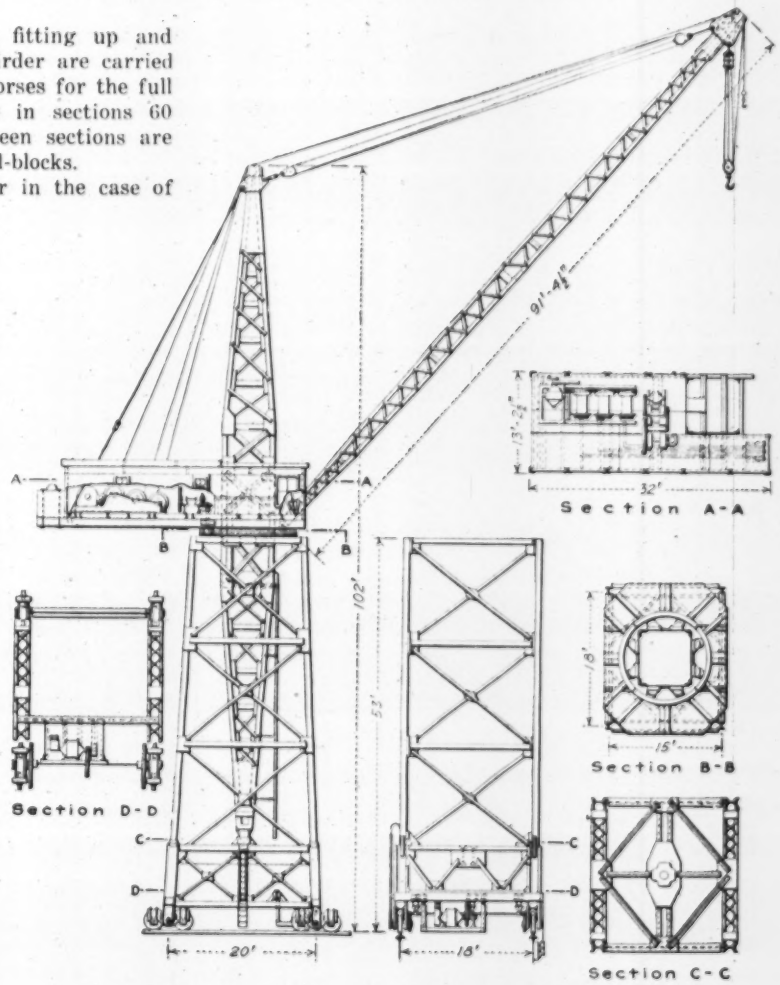


FIG. 5. REVOLVING TOWER JIB CRANES SERVE THE BERTHS

The Construction Division of Our Army: Operation and Maintenance Functions

Organized in Eight Sections—Each Completed Project in Charge of Utility Officer—Plea for Continuance as Independent Unit of Military Establishment

By George W. Fuller
Consulting Engineer, New York City

In A previous article, in *Engineering News-Record* of Feb. 27, 1919, p. 416, the writer sketched the development which established the Construction Division of the Army as an independent organization reporting directly to the General Staff. The magnitude of the work was set forth, and some stress was laid on the type of the responsible organization, embodying as it does the experience and personnel of numerous successful civilian concerns.

In the present article, the writer endeavors to portray briefly the organization of the Building Division and also to set out both the work and the organization of the Operating and Maintenance Division. This more detailed description of those two branches of the Construction Division is of general interest both from the subject matter itself and the bearing which it has on the important question of preserving the division as an adequate entity and with a personnel commensurate with the work still to be performed. There will be set forth in a later issue some maintenance costs and other operating data of interest to engineers engaged in the utility field.

Organization of the Building Division

The principal scheme in the organization of the Building Division is the separation of the construction work into six groups or sections, each under the direction of a section chief whose work embraces one or more types of projects. For example, one section chief handles all ordnance work, another warehouse and terminals, another camps and cantonments, and so on; each section chief has four general assisting units, consisting of an engineering unit, an administrative unit, a materials expediting unit and the unit in charge of estimates and costs. The two latter units act as liaison officers with the Procurement and Engineering Division.

Under each section chief the direction of the field operations again divides geographically under the control of four or five supervising constructing quartermasters, each of whom is responsible for the work of from five to fifteen different projects. The constructing quartermaster, who is the Army's chief representative in the field, communicates with Washington only through his supervising constructing quartermaster, who thereby is enabled at all times to keep in touch with the progress of the work.

Serving all sections and acting as a part of the Building Division there is set up a Requirements Branch, which is charged with all questions dealing with special requirements, including responsibility for the allotment of funds to the various jobs. Furthermore, it has supervision of all requests for funds and statements covering new work which are sent to the Secretary of War or General Staff for approval, and the preparation of necessary reports and statements to the various Congressional and Senate committees and the War College, and of other similar requests for data.

Even after construction is completed and the project put in use, the duties of the Construction Division are by no means finished. Indeed, the operating problem begins before the construction work ends, as the housing of troops commenced, for example, before the camps were finished. Some agency must be set up for a wide range of tasks, such as keeping the streets and roads in repair, operating and maintaining the water and sewerage systems, operating the electric-light and power systems, and making repairs and minor alterations to the thousands of buildings. These are the functions of the Operation and Maintenance branch (officially known since September, 1918, as the Maintenance and Repair Division) of the Construction Division; they have to be exercised at military posts, camps, cantonments, hospitals, terminals, depots and other establishments coming within the jurisdiction of the War Department.

Earliest Efforts at Maintenance and Operation

During 1917 and the early part of 1918, when the Construction Division (or Cantonment Division, as it was then called) was a part of the office of the Quartermaster General, the field forces engaged in operation and maintenance were under the jurisdiction of the local camp quartermasters. These officers were naturally picked for the better known duties of quartermaster—subsistence and personnel supplies, troop transportation, pay, etc.—and their hands were amply full with such duties. Naturally, their experience with operation and maintenance on Army reservations was on the small-post peace-time basis, where the big-cantonment war-time problems never arose. Therefore, the first utility officers placed in immediate charge of cantonment operation and maintenance labored under truly enormous handicaps. There were (1) a deficiency of enlisted personnel; (2) a lack of local appreciation, higher up, of the number of men and the amounts of material demanded by the situation; (3) a slowness in organizing in Washington a centralized operation and maintenance bureau to give adequate help to the local forces. The severe winter of 1917-18 still further added to the burdens of the field forces, and—in the northern cantonments, at least—the camps were kept running only by long hours of arduous duty on the part of officers and men, and by twisting the Army regulation red tape considerably out of its intended form. It is needless here to do more than mention the indefinite and apparently overlapping jurisdictions, during this period, of camp quartermaster, camp surgeon, sanitary corps representatives (medical department) in relation to the utility officers who had to deal also with representatives from numerous offices in Washington.

It was not until the Cantonment Division emerged from under the wing of the Quartermaster General's office that proper development of the operating division was possible. Then the local utility forces were dis-

sociated from the local quartermasters and made directly responsible to the military commander of the reservation and to the division now called the Construction Division, which supervised the work and the funds required therefor.

It was in May, 1918, that utility operations received their first impetus toward adequate expansion. However, the Army deficiency bill, of March, 1918, provided no funds for betterments, and the expansion program proceeded in a restricted way. With the beginning of the new fiscal year, July 1, adequate authorization came for increased personnel and for needed funds. Especially in view of shortages of men and material, much credit is due those who sought to bring methods successful in similar civilian undertakings to the aid of the large Army camps.

Organization for Operation and Maintenance

By the end of 1918 there were under the jurisdiction of the Maintenance and Repair Division the roads, buildings and public utilities in 46 camps and cantonments; 51 hospitals; 66 border stations; 25 supply depots and terminals and 171 regular military posts. For the fiscal year ending June 30, 1919, the funds for its use amount to $62,400,000.

It had as a field force, concerned with the actual operation of its functions at all of these points, 452 commissioned officers and 16,559 enlisted men. The maintenance and repair personnel in the Washington office consisted on that date of 40 commissioned officers and 126 civilians, of whom about 90 have been engaged in work for the entire Construction Division in the blueprinting and photostat rooms.

The organization of the Operation and Maintenance Division parallels the general scheme of the Construction Division of the Army in that it follows so far as practicable the precedents indicated by civilian experience on a large scale. The division is divided into a series of eight branches or sections: (1) Personnel; (2) service; (3) statistics; (4) procurement, which has been combined with the service section; (5) building repair; (6) fire protection; (7) light, heat, power and refrigeration; (8) water and sewerage.

Coördination of Central Office and Field Forces

To keep in touch with these utilities at so many posts and locations requires an efficient and complete central organization. At the same time, such a bureau must not be so highly organized as to impede its own work. The Washington office, in order to maintain intelligent supervision of these utilities scattered all over the United States, must be kept advised as to what is going on, as well as to what are the actual needs. Utilities officers look to Washington for prompt authorization of funds for repairs and extensions, for advice on matters of policy, and for information on countless points which arise.

There are two methods by which the central office acquires information. One is by reports of inspectors, and the other is by the study of the reports of the utilities officers themselves. A utilities officer is busy and has little time for the preparation of reports. Accordingly, only monthly statements, containing information in the most concise and brief forms, are required. These reports are usually headed by a summary outlining matter of particular importance, recommendations as to needs, etc.

When a report is received from a camp or other location, it does not follow the commonly supposed fate of such Government documents, that of being filed away in archives without other than a hasty examination. It is carefully studied for two purposes; (1) To find out what has occurred during the previous month at the job, and (2) to analyze the proposition better from the viewpoint of efficient and economical operation. The report is scrutinized by the chiefs of sections or branches, who attach memoranda with any comments or remarks. The officer in charge of the Maintenance and Repair Division then studies the questions of policy, and conditions requiring correction are noted, and communications with instructions are prepared through the aid of the memoranda attached by the section chiefs, and forwarded to the local or camp utilities officer.

At each completed project, in charge of the operating force is an officer selected on his record in civil life in the management of public utilities, holding a position comparable to that of a city manager, but with detailed responsibilities and duties far transcending those of such an official. Indeed, he is a composite of city manager, city engineer, fire marshal, street and building inspectors, managers of municipal water-works and sewers and telephone and electric-supply companies and cold storage, besides being general all-round handyman to whom everybody comes to get anything fixed.

The local organization is military in its character, and was worked out with a view to obtaining the greatest efficiency and the best results with a minimum of personnel and expense. A major is usually placed in charge of this highly important work, and has as assistants a number of commissioned officers of lower grade. For operative and clerical assistants there is a detachment of enlisted men, depending as to the number upon the size of the project, but varying from 300 to 800 in various camps and cantonments.

Each utilities officer maintains in his office a "trouble department"—a desk over which passes every complaint of whatever nature and every request for repairs and replacements. In addition to the written communications received, the number of telephone calls in the trouble department at each camp alone averages several hundred per day. All the work is supervised, coördinated and administered from the Washington office. Refinements and economies are constantly worked out, and their effect is always toward giving the greatest service with a minimum expenditure of public funds. The Maintenance and Repair Division of the Construction Division's office is really a huge service organization operating for the benefit of over a million persons, and designated to supply them with every convenience and comfort incident to their existence as soldiers stationed at Army posts.

Future Work of the Construction Division

The writer will endeavor to set out below a brief consideration of some of the factors affecting the future operations of the division and the volume of work to be done in peace times.

When the armistice came in November the Construction Division had under way or completed nearly 1000 contracts for new construction work and was operating utilities at and keeping in repair about 350 military establishments.

While during peace times the demands for so extensive a program will cease to exist, nevertheless, to

provide proper housing for an army of 175,000 men will call for additional permanent construction equal to nearly twice that existing previous to the war.

Undoubtedly, many of the large Army camps will be retained, and the temporary buildings will be improved to provide more comfortable quarters and to give them a more permanent character. This work will extend over a period of years and will total a substantial amount. Then, too, the housing construction on the Mexican border has been of a most temporary and frequently makeshift nature, and much new construction of a more durable type is badly needed there. With our small pre-war army of 70,000 men, the annual building operations were of considerable magnitude, so it is obvious that whether the future Army consists of 175,000 men, or 500,000 men or more, as desired by the advocates of universal military training, the annual new construction for the Army will total many millions. As a matter of fact, there is now proposed one project, a permanent school for the Corps of Engineers, which alone will probably cost from $25,000,000 to $30,000,000. If all other new construction combined for the next fiscal year is only three or four times that of the new school for engineers the total will range from $120,000,000 to $150,000,000.

It has been pointed out in these pages that operation and maintenance and ordinary upkeep form a large undertaking, involving, as they do, investments in structures of a temporary character, whose worth is about $500,000,000, and requiring at present monthly expenditures of about $4,000,000.

Operation and maintenance activities and expenditures will be reduced, but never to a point comparable with the pre-war expenditures. One reason for this is that the pre-war practice of housing troops in widely scattered posts of very small capacity prevented any possibility of training the Army in maneuvers or of mobilizing the men in any way for modern training on a large scale, and the experience of the war has clearly proved the need of maintaining large training centers such as the cantonments provide. Therefore, the operation and maintenance of at least a large percentage of them must continue, as well as many hospitals and also supply depots and terminals representing permanent investments.

Large Expenditures Required

Even though exact figures cannot be foretold, it is clear that even in peace times new construction and operation and maintenance will require large expenditures. It would be unwise and inconsistent with good business to place responsibility for such work in the hands of those unfitted by training or experience to handle these matters, and more especially is this true when it is remembered that there now exists in the Construction Division a highly specialized organization of experienced civilian engineers. These men have made good under unprecedented demands and conditions. No untried agency can handle as efficiently or economically the peace-time requirements.

Some of the lessons of the war stand out strikingly. We were entirely unprepared for war, and most of all in those lines of work of the military establishment where those in responsible positions needed a thorough knowledge of commercial practices and the hard, keen business sense acquired through commercial experience. In the regular military establishment there is no opportunity for the soldier to acquire training or experience akin to that obtained in large civilian organizations. Ordinarily, his training is such as to give him no idea of the value of a dollar or of competitive conditions of production and procurement. From the time he enters West Point the officer is in a measure set aside from commercial pursuits, and if his line of duty brings him in contact with matters of engineering or production he nevertheless loses the value of the practical and competitive circumstances under which his civilian brother labors.

Division Met All Demands

Because it was a civilian organization reinforced with a knowledge, through years of practical experience, of how to obtain materials, transportation and results in the face of adverse conditions, the Construction Division was able to "deliver the goods." The obstacles overcome were not alone those in the field or in the actual construction or operating activities. In fact, the greatest handicap, especially at the start, was the lack of preparedness for the work to be done. Obstacles could not in any large measure be studied in advance, but under the press of immediate needs each problem had to be solved as it arose, and the rapidly increasing scope of the work called for constant changes in the organization. It is fortunate that those experienced constructors who were early called to the division selected certain broad principles of organization which stood the test of constant expansion. Even so, mistakes were made, principally because when the war was started there was no complete scheme of organization susceptible of unlimited expansion and no program for immediately starting construction activities. But the division, nevertheless, met all demands made on it. Praise without stint is due those who put through and were responsible for this great engineering and constructive work, and it should be their reward, as many of them return to civil life, that they go with the knowledge that unquestionably, for the public good, profit has been taken from their successes and their failures and the organization they built shall neither pass out of existence nor lose, by absorption into some other bureaus of the War Department, its entity and that strength which it now has by virtue of the rich practical experience of its civilian engineers and constructors, whether in uniform or not.

There has been suggested a Department of Public Works to handle all construction activities of the various bureaus of the Government. The retention of the Construction Division of the Army would perhaps serve to give an instrument ready at hand in connection with the establishment of such a Department of Public Works.

Pre-War and Present Highway Costs

In 1915 the New York State Highway Department constructed 1073 miles of highways, at an aggregate cost of $11,790,000. At present prices of labor and material but little over one-half of this mileage could be awarded at the above sum, according to the annual report of Edwin Duffey, state highway commissioner. A comparison of the pre-war and present costs of pavements is given in the report as follows:

Item	Cost per Mile—Pre-war	Present
Water-bound macadam	$12,000	$18,000
Bituminous macadam	14,000	22,000
Concrete	18,000	28,000
Brick	25,000	$5,000

Accurate and Compact Record of City Property

New Castle, Penn., Has System of Maps and Forms Covering Entire City to Record Property Titles and Transfers

A SYSTEM for keeping city records of real estate titles has been worked out in the City of New Castle, Penn., under the supervision of C. H. Milholland, city engineer. It consists of various maps, forms, numbering and index marks to locate readily the data for any particular parcel of land within the city limits. The aim is compliance with the Pennsylvania state law, which requires that such a record be kept in all third-class cities.

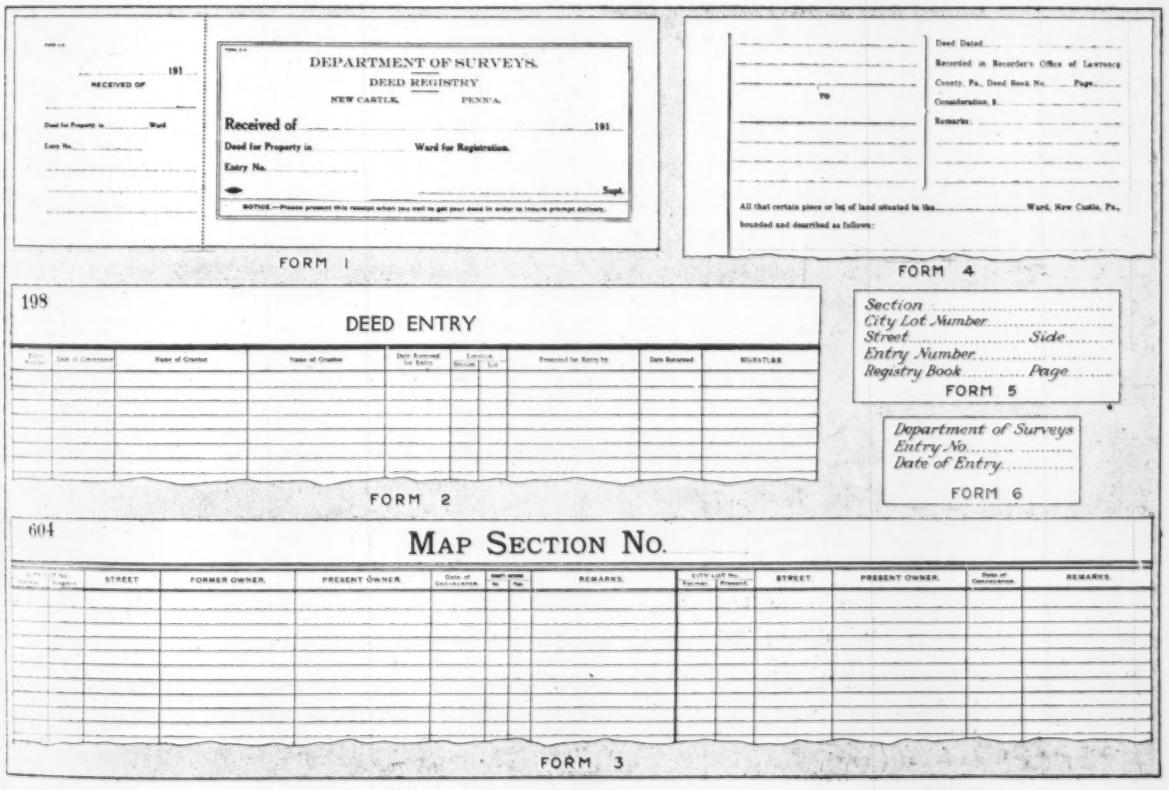
In establishing such a system the first step is to make an accurate set of maps showing the street and property lines of the city. A complete survey was made of all streets, and stone monuments, 4 ft. in length and 8 in. square, were placed at each street intersection or street corner. These monuments were also placed so as to be used as bench marks.

As a basis for the preparation of the maps, the city was divided by the city ordinance into 100 sections. The ordinance also provided that each city lot should have a number, so that each lot could be designated as lot No. ——, section ——. Where subsequent subdivision of any lot or tract of land occurs, it is prescribed that each subdivision shall receive the same number, with a letter of the alphabet added to distinguish the various subdivisions.

The scale chosen for the maps was 50 ft. to the inch, this requiring sheets 30 x 48 in. These were made of linen-backed paper. Upon them are shown the center lines of the streets, with bearing and distance in red; stone monuments as small black squares; street lines, lot lines and lot distances in black, and the recorded plot number, if there is one, in blue. Each of the 100 sections has lot numbers running from 1 to 600, and these are shown in red figures. For the purpose of obtaining the information required, the city ordinance provided that each owner of real estate should submit his deeds to the city engineer for registry and prescribed suitable penalties for failure to comply. These original drawings are not shown to or handled by the general public, but tracings of them have been made on which the name of the owner is shown in black, and when there is a transfer of ownership the name is changed.

When deeds are presented, Form 1, as here reproduced, is used to give the owner a receipt. These receipt forms are in a book of about 200 pages. When the deed is returned this receipt must be presented and signed by the owner. Form 2 is used in registering the submission of a deed for entry, and recording the various information as shown. The last column provides for the signature of the owner when the deed is returned. This form is made in a book of 200 pages.

When the registry has been made a book of 600 pages, the headings of one of which are shown in Form 3, is used to record the registry with the proper city lot number, the section number, etc. The form provides for 14 transfers of property. On the map as described above are placed in yellow figures the number of the



RECORD FORMS ARE USED AT NEW CASTLE, PENN., FOR REGISTRY OF ALL REAL ESTATE

registry book and the page; thus 2/25 shows that the lot is recorded in Book 2 on p. 25 of Form 3.

Records of the description of deeds are kept in a steel filing case with 100 files—one file for each of the 100 sections in the city.

Form 4, copy of the deed, is folded and stamped upon the back with Form 5 and placed in its numerical order in the files. Form 6 is stamped upon the deed when it is returned, and is evidence that the law has been complied with. The state law provides that, unless such stamp is found upon a deed, it cannot be recorded by county authorities.

This system of registry may be kept in compact form by having a combination plan case and book rack. At New Castle the plans are kept in 10 drawers, 10 plans to a drawer. The corresponding books are kept in 10 racks placed beside the drawers, the supports for the books being rollers, for easy handling.

After the installation of the system the council authorized the appointment of a registry superintendent, who attends to the details, furnishes copies of transfers to the city assessors and marks same on their plans. He also acts as clerk in the engineering office, issues street permits, shows plans when requested, etc. Mr. Milholland states that, after operating for some time, these methods have been found quite satisfactory.

Rotary Screens Remove Dirt from Water at St. Paul

Drums Have Shells Built Up of Screen Sections—Wash Water Received by Hopper Is Discharged Through Axle

MOTOR-DRIVEN rotary screens of the drum or cylindrical type are being used for removing vegetation and solid particles from the drinking water at St. Paul, Minn., and, it is reported, are giving satisfaction.

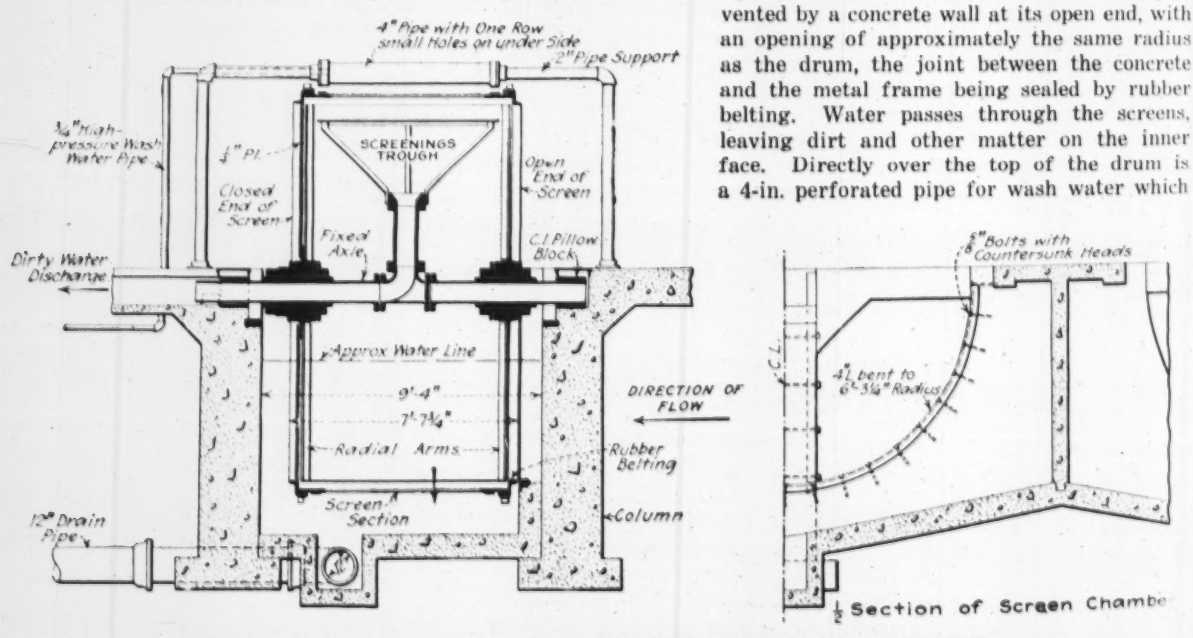
They were put in service in November, 1917, and have operated continuously since that time, requiring practically no attention. Two screens are installed, with space for a third. Stationary screens used previously were difficult to clean and required almost constant care.

Each screen is about 14 ft. in diameter and 7 ft. long, having a framework of structural steel and being mounted on an 8-in. horizontal shaft. One end is open for the entrance of water, while the other is closed by steel plates. The frame is covered with 24 sections of 80-mesh screens of monel metal, reinforced by a ¾-in. mesh of No. 8 copper wire. The shaft is fixed and the screen drum revolves upon it, being carried by two sets of roller bearings, so that little power is required to drive the screen. For each screen there is a 7½-hp. motor geared to a cross shaft having pinions which engage two circular racks on the screen, as shown, any

MOTOR-DRIVEN DRUMS SCREEN WATER-SUPPLY

tension being taken up by a differential gear. A speed regulator and two changes in the gears provide for varying speed to suit cleaning required. Normally, the screen makes about one revolution per minute.

The escape of water around the screen drum is prevented by a concrete wall at its open end, with an opening of approximately the same radius as the drum, the joint between the concrete and the metal frame being sealed by rubber belting. Water passes through the screens, leaving dirt and other matter on the inner face. Directly over the top of the drum is a 4-in. perforated pipe for wash water which



WASH-WATER HOPPER IN DRUM DISCHARGES THROUGH HOLLOW AXLE

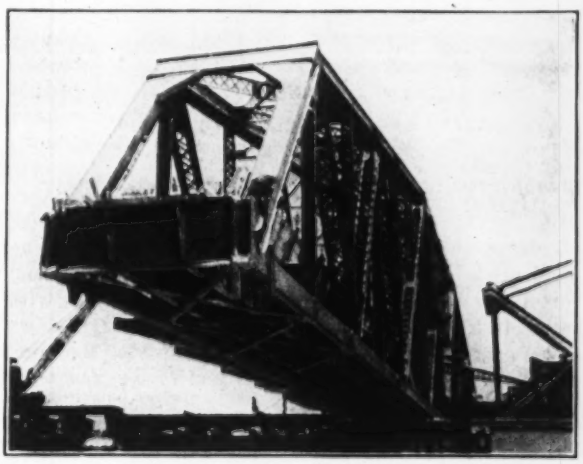
is discharged under 85-lb. pressure. Inside the upper part of the drum is a 4 x 6-in. trough or hopper, which receives the wash-water and dirt. In this way the screen can be cleaned continually with about two gallons of wash water during each revolution. It has been found, however, that the screens operate effectively when the wash water is turned on during one revolution about every 30 minutes. During 1918 the two screens passed about 17,000,000 gal. daily, while the maximum capacity per screen is estimated at 30,000,000 gal. a day. The screen chamber is so built that either or both screens can be shut off and the water passed around them without screening.

These screens were designed under the direction of G. O. House and W. N. Jones, who were, respectively, general superintendent and engineer of the Bureau of Water at that time. They were built by the St. Paul Foundry Co. The screen chamber was designed and constructed by J. W. Kelsey and L. N. Thompson, engineers of the Bureau of Water, all work being done by force account.

Cantilever Erection of Draw in Open Position While Old Draw Serves as Fixed Span

New Swing Span Part of Union Pacific Bridge Over Missouri at St. Joseph—Old Span During Work Carried Traffic

CONSTRUCTION of a new 465-ft. swing span on a new pier, to replace the old 358-ft. span, was the second step in the improvement of the Union Pacific Ry. bridge over the Missouri River at St. Joseph, Mo. The first step was the shifting of three 297-ft. fixed spans longitudinally for a distance of 136 ft. Owing to the condition of the old masonry, it became necessary to build new piers, and as an increase in length of drawspan was imposed by the War Department, it was decided to keep the bridge on its original alignment, building new piers between the old ones. The work of shifting the fixed spans into the new position was described in *Engineering-News Record* of Mar. 13, 1919, p. 550. During the erection of the new drawspan, traffic had to be maintained over the bridge, and this averaged about 75 trains and 400 teams and automobiles daily. River traffic also had to be considered, and for this a temporary lift span was provided. This was not needed, however, as all the work at the draw was done in the winter, while the river was closed to navigation.



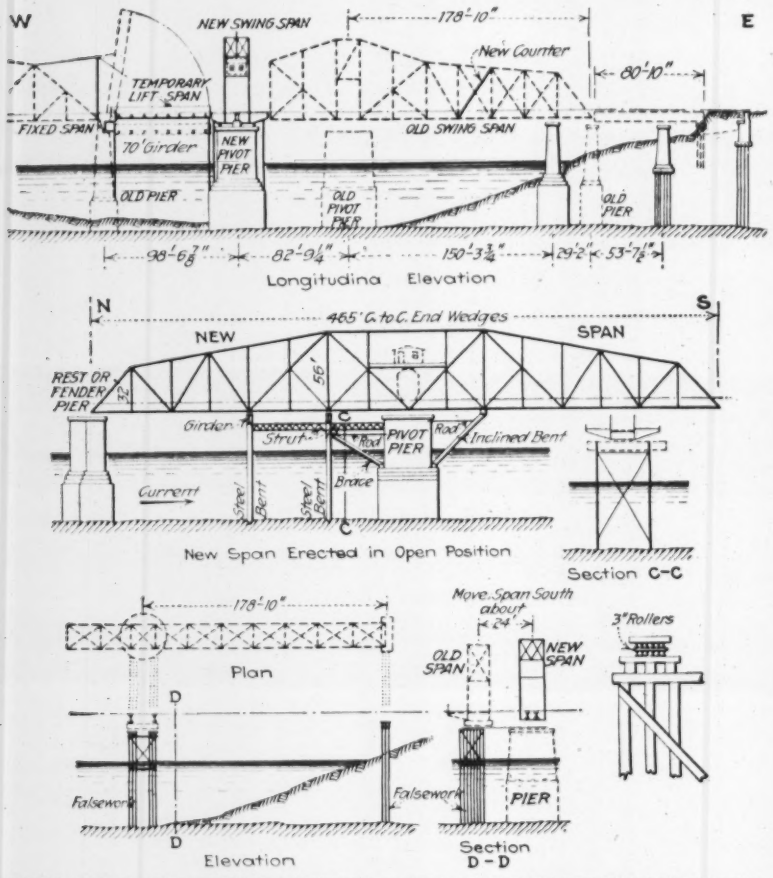
NEW SWING SPAN IS COMPLETED IN OPEN POSITION

Erection of the new drawspan was facilitated by the fact that this span was to be placed on a new pivot pier, in line with, but 83 ft. west of the old span. By erecting it in its open position the only interference was at the point of intersection. The old draw, therefore, was left in place, in its closed position, as a fixed span, but five panels of its west arm were cut off to make room for the new work. The layout of the erection scheme is shown in the accompanying diagrams. Work was commenced as soon as the shifting of the fixed spans had been completed.

A cantilever arm was formed by this shortened or bobtail west arm of the old span, with its end floor-beams only about 2 ft. from the ends of two of the roadway floor-beam brackets of the new draw, these being practically in line with the stringers of the old draw. Blocks bolted to the face of the floor-beam and to the ends of the brackets supported cross-timbers which closed the gap and on which were laid the intermediate ties. To prevent any yielding or lateral movement of the brackets they were supported by a timber bent having its cap cut to the slope of the brackets, as shown in one of the drawings. Removal of the end panels of the old drawspan, as noted above, left an opening between the new pivot pier and the west pier of the old draw. This was utilized for the temporary navigation channel, as shown. A through girder span of 70 ft. was placed here, being pivoted over the old pier and designed to be raised by tackles. Owing to the early closing of the river by ice, however, it was evident that it would not be necessary to operate it. Therefore, when the trusses of the old draw were cut off to permit the erection of the new span in its open position, the floor of the old draw was blocked up on the 70-ft. girders, and traffic was maintained over it without disturbing the track.

To carry the operating track through the new span during its erection, ties were laid temporarily on the drum of that span. The traveler erecting the new span was able to cross this track without disturbing it, by means of rails having slots cut in the webs so that they could be dropped over the rails of the operating track. These slotted rails were removed as soon as the traveler had passed.

As the bridge is raised to a new grade, a temporary



STEEL BENT AND GIRDER SUPPORT PANEL POINT OF NEW DRAW DURING ERECTION OF MISSOURI PACIFIC BRIDGE AT ST. JOSEPH, MO.

inclined runoff was required to connect the new elevation on the bridge with the old grade on shore. This was formed by laying additional ties on the stringers and placing upon these tapered jack stringers which carried the ties of the operating track.

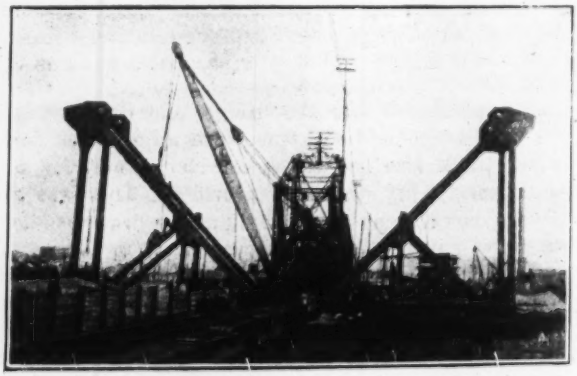
For the new 465-ft. single-track swing span, through trusses of the Warren type are used, these being 56 ft. deep at the middle and spaced 12½ ft. on centers. Floor-beam brackets carry 15½-ft. roadways outside of the trusses. The weight of the span is about 1717 tons, exclusive of the machinery, which weighs 90 tons.

Preparation for work on the new drawspan included the driving of two steel bents, distant 58 ft. and 116 ft., respectively, from the center line of the bridge, to support the first portion of the upstream arm, leaving 116 ft. to be continued as a cantilever until it reached the fender or rest pier. Each bent was composed of two steel piles connected by diagonal bracing having pin connections to allow flexibility in sinking. Each pile was of H-section, composed of three 24-in. 80-lb. I-beams, 78 ft. long, with batten plates over the flanges and having a cast-steel point about 2 ft. long.

Sinking the piles to rock through 35 ft. of sand was assisted by two water jets at 175-lb. pressure and the points were then driven about 2 in. into the solid rock by a five-ton drop hammer. Each pile carried one of the diagonal braces, attached to a pin connection near the foot. This connection permitted the brace to be held in vertical position while sinking, and then to be swung out for attachment to a pin connection at the head of the other pile. As the bents were embedded deeply in the silt, this had to be cleared away temporarily by water jets, to enable the braces to be swung across, as described. The upper half of one brace was made wide enough to allow the other brace to lie within it. A special floating piledriver had to be built to handle these 80-ft. steel piles, each weighing about 28 tons, including the bracing.

Each bent carried a 60-ft. plate girder seated upon shoes on the tops of the I-beams which formed the webs of the steel piles, the two outer beams of each pile being extended above the girder, as shown in one of the photographs. These girders were used later in the new approach. The two girders supported the first portion of the upstream arm of the draw, as noted above. The bents were braced together and to the pier by horizontal steel struts, while the first bent was braced against the pier by a timber raking strut or bent, to resist the thrust of ice and drift in the river. After completion of the work the girders were removed and also the upper parts of the diagonal braces of the bents, the steel piles being then cut off by torches at the ice line, as they were too firmly embedded to be pulled up.

To carry the first lengths of the chords on the downstream side, an inclined timber bent was seated on the footing of the pier, with its top anchored by rods built into the pier. The cap of this bent supported the first panel points of the downstream end of the span. This method of support was planned during the early part



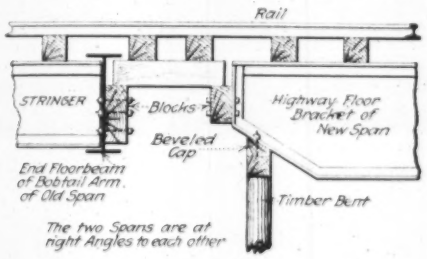
ERECTING CRANE PLACES 80-FOOT 41-TON POST OF NEW SWING SPAN; HIGHWAY PASSES THROUGH PANEL

of the work and the bent was erected, in vertical position, within the cofferdam. With the turntable center erected on the new pier, the derrick car first placed the bottom chords for the four middle panels, the outer ends of these being supported on the steel

bent and inclined timber bent for the upstream and downstream panels, respectively.

Then the panel verticals were erected, followed by the end posts extending from the turntable to the tops of the verticals. Each end post was complete in one piece 80 ft. long and weighing 41 tons. No slings were used in handling them, but hitch plates were riveted at such positions that when attached to the hoisting hook of the derrick the post would swing at approximately its normal inclined position. This facilitated setting this long and heavy member in place. Chord sections weighed from 13 to 18 tons. On the completion of the upstream arm, it served as the anchor for the downstream arm, which was built as a cantilever beyond the inclined supporting bent.

The erection of the end posts at the center of the new draw, with all those members composing the central four panels, was done with a 150-ton locomotive crane that had been built specially for the erection of the long fixed spans at the Metropolis bridge over the Ohio River. The balance of the truss was erected with a



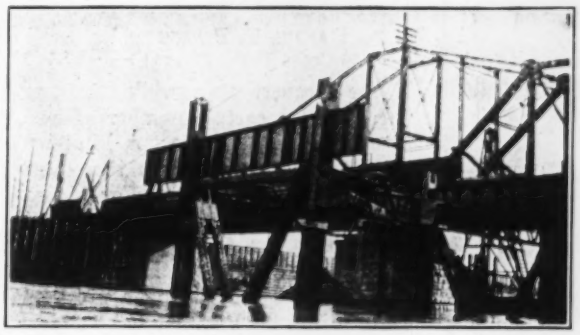
TEMPORARY TRACK CONNECTION BETWEEN THE TWO SPANS

through traveler running on the deck of the new span. This traveler was equipped with a 75-hp. electric hoist. Material was carried out to it on a track supported by the highway floor-beam brackets.

Highway traffic, during erection of the new draw, was carried on the upstream roadway of the old draw, as there was room for teams to pass under the batter posts in the upstream arm of the new span. The old roadway and the brackets on the downstream side were removed, rails being piled against the truss to counterbalance the weight of the upstream roadway. In the 136-ft. opening left by the shifting of the fixed spans for this distance, the track and the roadway were carried on timber pony bents. The main part of each bent rested on blocking on the falsework and carried the railway track, while the projecting cantilever end carried the highway. One of the views shows the crane setting these bents on the falsework.

The removal of the remaining portion of the old span, to permit of closing the new span, was effected by shifting it downstream a distance of 22 ft. This was done on 3-in. rollers laid on rails on pile falsework forming extensions of the old east pier and old center pier. The weight was about 550 tons and the span was moved by means of two nine-part tackles operated by hoists placed on each end of the old span. Both railroad and highway traffic were then operated on the track deck of the new span until the trusses were riveted, this being done to prevent any distortion in the trusses due to outside loading. With the riveting completed, the highway floor was laid on the upstream side.

For dismantling the old span, the floor-beams and bracing were first removed. Then the outer truss was

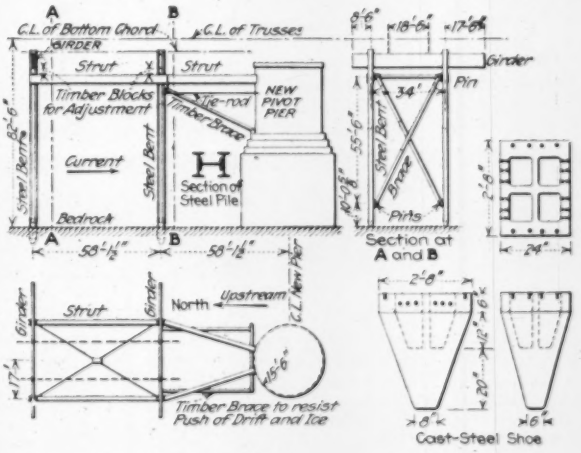


TRAVELER ON CANTILEVER CONSTRUCTION OF SWING SPAN OF ST. JOSEPH BRIDGE

moved back onto I-beam brackets attached to the new span, the latter not being required to open, as the ice still prevented river traffic. The trusses were taken apart by the aid of a derrick placed on top of the east arm of the new span.

When the old draw was rolled out and the new one closed, there was a gap of 28 ft. left between the end of the latter and the old falsework, until the old draw was taken down. Then the 80-ft. girders were rolled 28 ft. endwise to the west, and the new 60-ft. approach spans were erected.

The reconstruction of the swing span and the shifting of the fixed spans were undertaken by the American Bridge Co., under the personal supervision of K. L.



STEEL PILE IS BUILT UP OF THREE 24-INCH I-BEAMS

Strickland, division erecting manager; T. S. Melton, foreman, and A. F. McLane, resident engineer. The work was done for the St. Joseph & Grand Island Railway Co., under the direction of R. L. Huntley, chief engineer of the Union Pacific System, with H. M. Stone as resident engineer, the entire project being under the general supervision of E. E. Adams, consulting engineer of the Union Pacific System.

Immediate National Reconstruction Work in France

Improvements to Navigation of Seine and Various Canals To Be Made, and Highways and Railroads Taken in Hand

By Major Daniel T. Pierce
American Red Cross, Paris, France

FORTUNATELY for France, even while the war was going on there were a certain number of men whose duty it was to prepare for peace. A Ministry of the Liberated Regions was set up when there was scarcely any liberated region to consider. For a year before the signing of the armistice another important bureau was studying plans for the development of France's colonial possessions. At the same time, the Ministry of Public Works was considering a program of public improvements within the Republic to be undertaken immediately after the war. The Under Secretary of State, M. Cels, recently consented to outline these plans as developed up to this time.

This program of the immediate public improvements includes the enlargement and increase of port facilities, canal and road improvement, railroad reconstruction, and many noteworthy projects for increasing the utility of rivers and canals.

Projects for Which Plans Have Been Made

The following outline represents only those projects on which agreement has been reached and for which plans have already been made.

Navigation on the Seine—The work to be undertaken here consists of the reconstruction of the dams at Andressy, Méricourt, Ville-Notre-Dame, La Garenne et Poses, and the removal of the dam at Melun. At each of the waterfall locks of the Seine new locks 660 ft. in length are to be constructed.

Bridges hereafter are to have a clearance of 6 ft. above high-water level, and many tributaries to the river are to be improved and deepened. Certain parts of the navigable channels of the Seine are much in need of rectification, and this work will also be undertaken immediately. The aim is to obtain a channel depth of 15 ft., which will permit bringing up the Seine River to Paris river barges of 2400 tons and seagoing barges of 1800 tons.

North Canal—Prior to the war, extensive improvements of this important waterway were undertaken. These are to be resumed at once, with the intent of making possible the movement of barges of 600 tons instead of those of 300 tons which were the largest barges that could be handled heretofore. The improvements are now to include the repair of the canal of St. Quentin, which repair is an immediate necessity in order that coal from the Northern mines may again reach the region of Paris by canal.

The Rhine Canal—Immediate execution will be undertaken of improvements to permit the use of the canal from the Rhône to the Rhine, throughout its length, by barges of 300 tons. A navigable way from Haute Alsace and the rest of the territory will be assured, handling among other important traffic the potash of the Alsatian region. This program will be extended later on by improvements on the Rhône which is a part of the plan of internal river and harbor work.

Canals of the South—Dredging and rebuilding of towpaths to permit the use of mechanical tractors, and the reconstruction of bridges, are included in the program of improvements for the Canal of the Midi (South) and the laterals to the Garonne. The effects of these improvements will be to increase greatly the efficiency of the southern canals as a means of communication between the ocean and the Mediterranean. Some important improvements on the Loire have also been adopted for immediate execution.

Highways—In the field of road improvements there is a decided inclination to adopt other forms of construction than those which have heretofore proved satisfactory. France obtained her reputation for good roads on the basis of the service given by macadam. This, however, was before the days of war traffic and multitudinous automobiles. Some new plans for road improvement in the territory between Paris and the Marne call for granite block for considerable distances through and beyond the numerous towns and villages. Stone block represents to the Frenchman the ideal of durability under the heaviest traffic, and he is not as yet prepared to change his mind on this point.

Railroads—On the subject of railroad improvement and reconstruction, it is impossible to speak definitely, for the reason that the destruction of the war-zone railroads has been so complete that the effort is simply to put into operating condition as speedily as possible the main lines radiating northeast from Paris. Even the most important of these lines are still in a deplorable condition as to state of roadway and structures, and the available output of steel is totally inadequate to accomplish what must be done before the railroads of the war zone can be restored to pre-war conditions, much less improved as compared with their former state.

American Operation Made Good Impression

Steel bridges will be almost universally adopted and somewhat heavier rail used, for while European railroad authorities are not willing to concede the greater efficiency of the very heavy cars and locomotives preferred in the United States, a very strong impression has been made by the performance of the American equipment imported to France for war purposes, and an even greater impression has been made by the efficiency of operation that prevailed on the lines under the American Expeditionary Forces.

It is evident that the program of internal improvement which must be carried out in advance of the reconstruction of towns and villages will call for a vast amount of material and machinery which France itself cannot supply.

Correction

Several typographical errors appear in the article entitled "Tests Show High Shear in Deep Reinforced-Concrete Beams," by W. A. Slater, in *Engineering News-Record* of Feb. 27, 1919, p. 430. The test beam shown in Fig. 1 was not 26 in. deep but 36 in. as stated in the text. In the shear formula in the first column the coefficient $\frac{3}{8}$ is omitted in the vertical stirrup formula. The second formula in the same line relates to diagonal stirrups. In the second column on p. 431 the coefficient for the deflection formula is 0.0833.

Keep Accurate Costs on War-Time Fee Contract

Figures on Small Concrete Bridge Job in Which Instability and Height of War Prices Prevented Lump Sum Bidding

By Farley Gannett and J. D. Carpenter
Gannett, Seelye & Fleming, Engineers, Harrisburg, Penn.

Costs of construction have changed so entirely during the past three years that the engineer's customary sources of information on costs are useless today, and every new evidence of costs under present conditions is exceedingly valuable. Not only were wages and material prices high, but the efficiency of labor was so low during 1918 that it was not safe to use ordinary standards of work and apply thereto the ratio of old to present wages. The construction of a small concrete bridge in Pennsylvania during the summer of 1918 is therefore interesting on account of the cost-plus-fee form of contract used, and by reason of the fact that careful cost records were kept and worked up, showing accurately actual costs at the high point in the rising prices of 1918 in this section of the country.

CONCRETE BRIDGE BUILT UNDER WAR PRICE CONDITIONS NEAR HARRISBURG, PENN.

The bridge was built for the York Haven Water and Power Co., which operates a 20,000-hp. hydro-electric power plant on the Susquehanna River 16 miles below Harrisburg, Penn. It is a two-span reinforced-concrete arch bridge across the tailrace of an adjoining paper mill, and carries a single-track railroad siding from the main line of the Northern Central R.R. to the power house. Its construction was imperative, as the old trestle which it replaced was unsafe for railroad use, and it was necessary to get heavy machinery into and out of the power house for repairs and replacement. Thus, the bridge had to be built, notwithstanding the high prices.

The contract was let for cost-plus lump-sum fee. The engineer's estimate of cost was $14,880 and the fee was fixed at $1860 or 12½%. Under the contract, if the actual cost exceeded the estimated cost for any reason except increased quantities, no increase was made in the fee, but if the actual cost was less than the estimated cost the owner and contractor shared equally in the saving. If, however, the quantities were increased or decreased, then the fee increased or decreased accordingly. The actual quantities varied so little on the total job that the final estimated cost was $15,000, as against the original estimated cost of $14,880. The actual cost of the bridge was $17,922.17, a little over $3000 more than the original estimate, but one-half of this excess was due to the raise in the labor wage per hour from 35c. when the estimate was made in April, 1918, and 40c. when the work was done. Before the work was let a lump-sum bid was requested from a contractor who was anxious to do the work, but, as his bid was $26,000, it was not awarded to him. This bid evidently included a large allowance for risk on higher wages and cost of materials, as any bid made at that time must have done. The company saved about $6000 by adopting the form of contract used instead of letting it on this lump-sum bid.

The bridge, shown in the view, has two 50-ft. spans with a rise each of 8 ft. and a middle 5-ft. pier. It is 105 ft. from face to face of abutments, 145 ft. from end to end of wing walls and 16 ft. wide out-to-out of side walls. The tracks are carried on an earth fill. The tailrace which the bridge crosses is about 100 ft. wide, with an approximate depth of 7 ft. of water therein and an average velocity of three miles per hour. The old trestle was used to transport materials across the tailrace and to support the arch centering on the new work.

The local labor was all employed in local industries, so colored labor was imported and a bunk house had to be built for them. The only machinery used was a concrete mixer and two pumps. Steam was purchased from the adjoining paper mill. The work was started May 27, 1918, and was finished Sept. 26, a total of 122 days. No great delays occurred, but the progress was slow owing to the great difficulty in getting and keeping labor.

The first work done was the excavation of the east abutment, No. 1, then the central pier and the west abutment. After the east abutment was poured, the concrete was placed in the pier and the east arch, and then the west abutment and arch were poured.

TABLE SHOWING COST DATA ON YORK HAVEN, PENN., BRIDGE, BUILT JULY-SEPTEMBER, 1918

	Bunk House	Cement Shed and Office	Travel	Excavation — Abutment 1	Excavation — Abutment 2	Cofferdams — Abutment 1	Cofferdams — Pier	Cofferdams — Abutment 2	Pumping	Small Tools
Labor at 40c. per hour	116 02	90 15	86 91	478 59	635 05	454 47	884 69	114 64	71 24	
Number of units				187 cu. yd.	500 cu. yd.	60 ft.	95 ft.			
Labor cost, unit				2 56	1 27	7 57	9 31			
Material cost	403 25	229 52				170 00	244 71	190 00	181 31	688 40
Total cost	519 27	319 67	86 91	478 59	635 05	624 47	1,129 40	304 64	252 55	688 40
Salvage	125 00	100 00								273 20
Net total cost	394 27	219 67	86 91	478 59	635 05	624 47	1,129 40	304 64	252 55	415 20
Total cost per unit				2 56	1 27	10 40	11 88			
Estimated cost	300 00	200 00		250 00	260 00	500 00	900 00	300 00	500 00	200 00
Estimated cost per unit				1 50	1 50					

	Materials, 1:3:6 Piers and Abutments	Concrete Mixing and Placing 1:2:4 Arches	1:2:4 Walls	Forms — Piers and Abutments	Forms — Arches	Forms — Walls	False-work for Arches	Reinforcing Steel	Removing Old Trestle	Taking Up and Relaying Old Track
Labor at 40c. per hour	1,181 65	751 45	417 28	511 44	476 90	987 46	780 89	598 32	215 51	62 87
Number of units	319 cu. yd.	208 cu. yd.	99 cu. yd.	319 cu. yd.	208 cu. yd.	99 cu. yd.		12.3 tons		
Labor cost per unit	3 61	3 62	4 22	1 60	2 29	9 98		48 60		
Material cost	1,347 92	1,334 33	645 90	230 66	552 81	317 61	360 89	1,119 77		
Total cost	2,529 57	2,085 78	1,063 18	742 10	1,029 71	1,305 07	1,141 78	1,718 09	215 51	62 87
Salvage	121 00	135 00	65 00	39 53	40 00	15 00	185 00	52 80		
Net total cost	2,408 57	1,950 78	998 18	701 57	989 71	1,290 07	956 78	1,665 29	215 51	62 87
Total cost per unit	7 56	9 38	10 07	2 20	4 75	13 03		139 50		
Estimated cost	2,164 50	1,903 20	759 45	360 00	945 00	1,200 00	800 00	1,235 00	200 00	75 00
Estimated cost per unit	5 55	9 15	9 15	0 92	4 54	14 46		130 00		

	Pipe Railing	Fill and Ballast	400 Ties	One No. 6 Frog	85-lb. Rail in Place	Waterproofing	Finishing Concrete	Cleaning Up	Totals
Labor at 40c. per hour	53 17	589 55		3 05	145 50	50 60	44 80	113 25	9,915 45
Number of units	290 ft.	900			4.7 tons				
Labor cost per unit	0 18	0 65			31 00				
Material cost	256 76	68 33	100 00	267 50	423 61	24 91			9,158 25
Total cost	309 93	657 88	100 00	270 55	569 11	75 51	44 80	113 25	19,073 70
Salvage									1,151 53
Net total cost	309 93	657 88	100 00	270 55	569 11	75 51	44 80	113 25	17,922 17
Total cost per unit	1 07	0 66	1 25		120 10				
Estimated cost	232 00	515 60	440 00	130 85	340 00	50 00	20 00	100 00	14,880 00
Estimated cost per unit	0 80	0 50	1 10		80 00				

It was necessary to do all excavation inside cofferdams which were mostly of double rows of timber sheet-piling, filled with clay by hand. Money was not spared in making substantial cofferdams; thus the cost of pumping was kept down. The cofferdam enclosing the east abutment was 3 ft. wide, with an average depth of 6 ft. The cofferfill was made with clay borrowed from a pit about 50 ft. distant. The pier cofferdam was also 3 ft. wide, but 10-ft. plank were used, as the water was 7 ft. deep. The wales were first framed and floated to location, where a skeleton coffer was assembled, the whole thing being supported by the old trestle and held in position in the current by wire lines. The skeleton was then sunk, sheathed and filled. Owing to the rough, rocky character of the bottom this coffer had several bad leaks, which were stopped with much trouble.

The coffer for abutment No. 2 was entirely on the bank, although rock was about 5 ft. below water level. A single row of built up tongue-and-groove sheathing was driven, making its cost considerably less than the others. The excavation here consisted of a mixture of cinders and wood scraps, which was wheeled and dumped about 100 ft. away.

One 6-in. centrifugal pump and one 6-in. siphon handled all the water coming through the cofferdams. As an indication of the items which make up the totals on the data sheet, the charge of $252.55 against pumping is distributed as follows: Rental, 88 days, at $1, $88; steam, $61.72; freight and repairs, $31.59; labor setting and moving pumps, $71.24.

After a thorough study of the materials available, it was decided that the gravel from a local deposit, which was offered at $1 per cubic yard of concrete, would be the most satisfactory. The deposit contained about 20% of clean sand under ¼-in.; 60% stone under 1 in.; 20% stone 1 to 3 in., with a few larger stones which were thrown out or used for plums in the 1:3:6 concrete. The gravel, after the sand had been removed, contained from 25% to 30% of voids. Working on the 30% basis, it was decided to use 30% of sand plus 10% of this to make a smoother mixture, or 33% of sand. In actual practice, however, this was found to make a concrete of a stony appearance and hard to work. The amount of sand was then increased to 40% of the gravel, which gave a more satisfactory mixture. A ½-yd. mixer was used, 10 revolutions being given the batch before dumping. Enough water was used to make the concrete easily workable, but no water collected in the form. The concrete was wheeled in buggies an average distance of 80 ft. The largest day's pouring was 110 cu.yd., dumping a batch about every two minutes.

The carpenters were local men, experienced in house building but not with concrete forms. The cost of forms ran high, especially in the beginning, on the 1:3:6 concrete.

The bents of the old trestle, used for falsework to support the arches, were cut below the spring line and capped. The centers were wedged 0.1 ft. above grade before concreting. During the pouring the arches settled about 0.15 ft., leaving the center 0.05 ft. low. The bases of the bents were on rock. The reinforcing steel was cut and bent on the job and placed by common labor. A clamshell was used for about 40% of the fill; the remainder was made with wheelbarrows with an average wheel of 80 feet.

The cost data show the total cost of each item, the

TABLE SHOWING UNIT PRICES PAID FOR MATERIAL

(All prices are f. o. b. job)

Lumber, 1-in. plank	$48 00	per M.
Lumber, 2-in. plank	48 00 to 51 00	per M.
Lumber, 6x6 in. to 10x10 in.	51 00 to 61 00	per M.
Cement	2 44	per bbl.
Sand	1 50	per ton
Gravel	1 25	per cu.yd.
Reinforcing steel—¼x¾ in.	0 038	per lb.
85-lb. rails	75 50	per ton
1¼-in. pipe railing	90	per ft.

labor cost, material cost, salvage and engineer's estimate. The unit costs are also shown.

The cost of excavation of abutment No. 1 was 75% above the estimate, but that in No. 2 was about 16% less than was estimated. There was, however, considerably more excavation necessary than was contemplated. The pier foundation required no excavation, as the current in the tailrace had washed the rock clean.

The costs of cofferdams, which averaged $11.30 per foot of horizontal length, were fairly near the estimate, while the pumping cost was only half what it was expected it would be. The 1:3:6 concrete in pier and abutments cost nearly 50% more than estimated, while the arch concrete came out very close to the expected cost. The reinforcing steel cost more than expected, largely because of the necessity of paying a higher price to get any steel at all.

The bridge was designed by Gannett, Seelye & Fleming, engineers, of Harrisburg, Penn., and was built under their supervision, with J. D. Carpenter as the resident engineer, by G. W. Ensign, Inc., contractors, of Harrisburg, Penn.

The cost-plus-a-fixed fee contract as illustrated by this bridge contract, wherein any saving over an agreed to probable cost is shared between the owner and the contractor, is not an entirely new form of contract, but its possibilities and equities have hardly been sufficiently appreciated. There is nothing to cause the contractor to attempt to increase costs, as in the cost-plus-a-percentage form, while there is a strong argument, in the way of additional fees, to cause him to do everything to keep costs down. There is no element of risk to the contractor, so he does not have to figure on one job to recoup losses on another. Such contracts will tend toward the employing of contractors who specialize in various forms of construction. Thus, the firm specializing in concrete bridges could be counted upon to build such bridges better and cheaper than a firm specializing in sewer work. Contractors will be employed on their professional ability rather than on their willingness to take a risk.

Under existing laws most municipalities must call for competitive bids and must let the contract to the lowest responsible bidder at a cost which is definitely set in the contract. Thus, it would not seem that much municipal work could be done under the form of contract here discussed until changes are made in the laws. Private corporations and individuals, however, may, and it is expected will, use this form of contract to their considerable advantage.

Efficient Methods of Financing Highway Bond Issues

Problem Has Many Factors Determined by Local Conditions—License Fees Work Well in States Lacking Good Roads

MANY different factors, which vary according to local conditions, enter into the problem of determining the proper method of financing highway improvements. Motor-vehicle fees may be used for highway construction or maintenance, according to the condition of the highway system in the state where they are to be applied. In states having no systems, they are particularly adapted to construction purposes, while in states where good systems exist they should probably be applied to maintenance. The above conclusions may be drawn from a paper presented by S. E. Bradt, state superintendent of highways, Illinois, and read by title before the recent convention of the American Road Builders' Association. The following is an abstract of the paper:

The provisions under which state bonds are issued by the various commonwealths are determined by the constitutions, which differ to a considerable extent. They are, however, generally uniform in the requirement that a proposition to issue bonds must be submitted in some form to a vote of the electors of the state.

In addition to complying with the constitution there are many other factors to be taken into consideration, as follows: (1) Present condition of the main roads of the state; (2) amount of mileage to be improved with state funds; (3) general type of the improvement; (4) estimated cost of the improvement; (5) assessed valuation of the state; (6) present rate of taxation; (7) all other sources from which revenue may be derived; (8) amount of bonds to be issued; (9) method of taxation to be adopted in liquidating the bonds that will be just and fair, and (10) maintenance of the roads after construction.

The consideration of these different factors will indicate immediately that the proposition is somewhat complex and that the same provisions will not be applicable to all states. In fact, if the provisions of a bond issue were worked out effectively, based upon local conditions, they would scarcely be the same in any two states. For any states with similar conditions, the Illinois plan of financing bond issues is efficient, equitable and thoroughly practicable. The plan differs from others chiefly in that, while the credit of the state is used to give the bonds stability in the market, the bonds are to be liquidated, both as to principal and interest, from the proceeds of motor-vehicle license fees. In order to bring about a sufficient revenue from this source, the fees which formerly averaged $5 per car have been increased to approximately $10 per car, which is about the amount paid now in every large state.

Every state in the Union has adopted the system of requiring that all motor vehicles be registered and a license fee paid therefor. In many of the states these fees are either in whole or in part turned back to the counties or townships and expended by local officials. It is generally conceded that, very frequently, the funds used upon the roads by local authorities are expended in such a manner as to bring no lasting benefit. In Illinois the money derived from this source has been segregated and was rapidly accumulating in the state treasury.

It is contended by some that these funds should be conserved, to be used exclusively for maintenance, leaving the improvement of the roads to be financed entirely from general taxation. It is undoubtedly true that the taxing of motor vehicles originated because of the damage which they caused to our highways. This was especially true of those stone and gravel roads planned for horse-drawn traffic, and before the days of the automobile. It is also willingly conceded, without

argument, that any state has the right to maintain its roads from motor-vehicle fees. However, Illinois has practically no improved roads to maintain. Its motor-fee collections, based upon the same schedule as other large states, will yield within two or three years from $5,000,000 to $6,000,000 annually. The demand for a connected state highway system, requiring a large amount of money, is insistent. Local and state taxes are already so high as to limit the amount that could be raised by general taxation for road improvement, to a sum which would be entirely inadequate. With these conditions in view, the State Highway department conceived the idea of using the accumulating fund as the basis for a construction bond issue.

If Illinois main roads were improved, as are the main roads of Massachusetts, then these motor fees could properly be used for maintenance; or if Illinois had already issued bonds, as has New York, and constructed a system of roads that require $4,000,000 to $5,000,000 annually for maintenance, then there probably would be no question as to the necessity for using motor fees for maintenance. However, with a very small percentage of improved roads to maintain, with no bonds outstanding, and with a growing automobile fund sufficient to pay the principal and interest on a $60,000,000 bond issue and still set aside from the same source an average of $2,500,000 for maintenance while the bonds are being liquidated, the plan to use this source of revenue appeared to be not only the most equitable, but also the most efficient method.

Whether it is equitable to pay the entire cost of any system of roads from motor-vehicle fees is often questioned. The argument is based upon the theory that road improvement benefits all of the citizens. This is readily admitted, and if the roads in the system were to be the only ones improved, the point would be well taken. In Illinois, however, the 4800 miles to be improved with the bond issue fund comprise only 5% of the total mileage of the state and will carry probably not to exceed 50% of the total traffic. The remaining 95% of the roads will be improved largely through local taxation, so that the general taxpayer will be afforded ample opportunity to pay his share.

Motor Vehicle Owners' Protection

There appears to be apprehension on the part of some people that this method of raising funds will lead to excessive taxation upon the motor vehicle. This danger seems very remote. Motor-vehicle owners today constitute a very large per cent. of the male population, and their relative number is increasing rapidly. Their numbers and influence will be sufficient to protect them against unjust and unsatisfactory legislation.

Finally, if the people are to pass favorably upon a bond issue, which involves a debt and the levying of taxes to meet this debt, then they must be convinced that the method of taxation is fair and just; and the man who is to be taxed must be convinced that he is getting value received from his outlay. In the campaign carried on for the Illinois bond issue, every motorist organization was enthusiastically for the proposition; and, so far as we know, every motor-vehicle owner was equally enthusiastic, although understanding fully that he was to pay the cost. The voters, 35 to 40% of whom are motorists, showed by giving the plan a large majority that they are convinced of its soundness for liquidating the bond issue.

In concluding, it may be stated again that the Illinois plan will not apply to every state in the Union, and is not the panacea for all the financial ills of all the states; but in states where the situation is similar to that in our state, with practically no improved roads, and with a large registration of motor vehicles, it is believed that, with some modifications, it will afford a sound, equitable and efficient method of financing.

Greater Activity Planned for the Hetch Hetchy Project

THE annual report prepared by M. M. O'Shaughnessy, city engineer of San Francisco, outlines recent progress on the Hetch Hetchy project, as well as the extent of activity for the coming year. The project is now in such condition, the report states, that $600,000 monthly can be expended efficiently in rushing it to completion if the bonds are sold so that this money is made available. During the past year the multiple-arch dam at Lake Eleanor has been completed and has for some time been serving the power house used to develop electrical energy for construction purposes. In addition to the power used on the project the city is deriving an income of $9000 per month from this temporary power plant, for electrical energy sold in San Francisco.

The most important feature of construction work now under way is the 18-mile tunnel between Early intake and the reservoir for the Moccasin Creek power house. This tunnel is now being advanced from three headings: From Priest Portal the heading has been driven in 1500 ft.; at South Fork an advance of 975 ft. has been made, and at Early intake the heading is in a little more than 1000 ft. Four additional headings will be used later in the work, one at the Priest Portal and two each from the shafts that are being sunk to the tunnel line at Big Creek and Second Garrotte.

The long tunnel is being driven on the day-labor plan at a price lower, the report states, than the engineer's estimate of $60 per lineal foot. The contractors' bids averaged about $90 per foot.

Attention will be concentrated on the long tunnel this year, as this will be the limiting factor in the completion of the first unit; i.e., the section above the Moccasin Creek power house, where a total of 66,000 hp. is to be developed under a head of 1215 ft. The longest single section of the tunnel will be the 4½-mile length between South Fork and Early intake, of which about 2000 ft. has already been completed. Six storage-battery locomotives have been purchased for hauling muck out of the tunnels, and an electric mucking machine is also being tried out. A small dam is necessary to complete the reservoir at Priest, the lower end of the long tunnel, and this, together with the penstock and power house, will be finished before the tunnel is ready for service. In case delay in financing makes it necessary to postpone work on the Hetch Hetchy dam, it would be possible to carry the Lake Eleanor dam to a greater height and to divert water from this source in addition to the natural flow of the Tuolumne River for developing power at the Moccasin Creek plant.

The fact that $1,000,000 worth of Hetch Hetchy bonds were recently sold, and an option on $8,000,000 more was taken up at the same time, is taken to mean construction work can be pushed rapidly during 1919.

Salt-Marsh Sand Clay as a Road-Building Material

Abounds in Tidal Lands in Texas—Primarily a Mixture of Epsom Salts, Gypsum, Clay and Sand—Economical to Use

ROAD surfacing with a material known as salt-sand clay, taken from the tidal lands of Aransas County, Texas, is being resorted to, with what are reported to be excellent results. The chemical analysis of this material shows that it is essentially a mixture of epsom salts, gypsum, sand and clay. When spread upon the road it hardens and produces a firm surface which has the appearance of sheet asphalt. The information following is contained in a report made to the State Highway Department of Texas by R. H. Phillips, county engineer of Aransas County.

Heretofore the material used for surfacing in this section has generally been oyster shells in various forms and conditions. At some points large shells were used, followed with a coating of finer shells mixed with sand; at other points the final coating was partially disintegrated oyster shells; while at still others the final coating consisted of small, fine shells obtained from banks thrown up on the beach.

The best surfacing locally obtainable has been what is known as "mud shell," taken from reefs in Aransas Bay. The shells, in varying sizes, from ¼ in. up, had voids filled with mud and sand. This fine silica sand, having a coating of silt which acted as a binder, solidifies under traffic and becomes a firm road surfacing. The salty nature of this material holds the moisture and keeps the road compacted.

As these reefs are accessible by wagons only at very low water or by the use of barges, sufficient material was not obtainable to provide for road-building projects. This resulted in experimenting with the material, from salt marshes, which has a composition similar to the mud sand filling in the coarser particles of the shell.

Character of the Material

The deposits drawn from are located in what are known as salt flats, at a distance anywhere from 100 to 3000 ft. from low water at the shore. In some seasons, these flats are covered with salt water for from four to six months. For the remainder of the year they dry out so that the material can be excavated.

There is considerable variation in the composition. The silt content varies in color from black to dark brown and some is even a light yellow. Although called sand clay, the sand largely predominates. The best material for road-building purposes is that which has sufficient silt to coat the grains of sand, thus filling the voids and binding the material when compacted. That considerable salt exists in this mixture is not only shown by the chemical analysis given in the accompanying table, but, as the marshes dry out in the warm weather, crystallization can be noted upon the weeds and grass.

Most of the material is taken out by hand and shoveled into wagons to be hauled to the job. There is generally a film of clean sand over the top, of thickness varying from 1 in. to 1 ft. When this is over 1 in. it is generally necessary to skim it off. Wheel-scrapers are used to advantage in many places to dig the material and haul it to the roads. It is necessary to select it so that it will have sufficient binding material. If this is not done, the road surfacing produced will quickly break up and give a condition similar to deep sand.

When first excavated, the material contains considerable water, but it drains sufficiently to be easily handled by the time it reaches the road. The original road crust is not disturbed, unless absolutely necessary, the material being spread evenly over it to bring it to the desired surface. The usual depth used is about 6 inches.

Heretofore the surfacing has been too narrow, as it is found that when wagons get off the road in passing they very soon cut through the crust at the edge and gradually destroy the entire surface. Even 16 ft. is not wide enough, and Aransas County has designated its highways to be 24 ft. wide, with shoulders not less than 2 ft. wide, to be solidly rolled to the same slope as the sand-clay surfacing. Heavy crowns are also a detriment to this type of road. The best crown is about ½ in. to 1 ft. After the surface is spread it is customary to allow the traffic to consolidate it, material being added to fill the hollows which develop as the packing proceeds.

When the road has hardened it has an appearance similar to that of sheet-asphalt pavement. Each night, even in the hottest weather, it absorbs sufficient moisture to keep it compacted and in excellent condition. One of its faults is that it has a tendency to be slippery in wet weather; when this condition is bad it may be overcome by giving the surface a coating of sand or shell. If the crowns are low, the slipperiness has not been found to give much trouble.

The annual wear is estimated at $\frac{3}{16}$ in., which is approximately 73.33 cu.yd. per mile. Add to this 50 cu.yd. per mile for filling depressions that develop under traffic, and figuring the material at 75c. per cubic yard applied, the maintenance cost for the surfacing will run about $100 per mile per year. A small motor truck with a three-blade drag will prove to be an economical means of keeping this road surface in first-class condition, it is said. It is also believed that

CHEMICAL ANALYSIS OF SAMPLE OF SALT-SAND CLAY

Substances Determined:	Per Cent
Silica	6.10
Alumina	5.10
Ferric oxide	little
Lime	13.20
Magnesia	7.95
Sodium oxide	0.53
Carbon dioxide	2.01
Sulphur trioxide	31.79
Chlorine	2.94
Loss by ignition (water and organic matter)	30.49
Total	100.11
Hypothetical Combinations:	
Water and other soluble matter	30.49
Sodium chloride	1.54
Magnesium sulphate	23.74
Calcium sulphate	27.37
Calcium carbonate	3.44
Calcium chloride	2.19
Clay	11.20
Total	99.97

an eight-ton roller would be a valuable addition to the maintenance and construction equipment.

Delivering the material upon the road costs about 34c. per cubic yard for a ½-mile haul, with the addition of about 6c. per cubic yard for each additional ½ mile. The spreading cost on the average is about 15c. per cubic yard. The information given was supplied by the Texas State Highway Department of which George A. Duren is state highway engineer.

Weights of Steel Roof Trusses by Empiric Formulas

Wide Variation in Results Obtained by Applying Rules to Practical Cases—Comparison With Estimated Weights

By R. Fleming
American Bridge Company, New York

MUCH ingenuity and study have been spent in the development of empiric formulas for determining the weights of steel roof trusses. Those given below have been brought to a common notation in which

T = weight of truss = WSD;
W = weight of truss in pounds per square foot of the horizontal projection of that portion of the roof supported by one truss;
S = span or distance between centers of supports in feet;
D = distance between centers of adjacent trusses in feet;
P = loading of truss in pounds per square feet of horizontal projection of roof;
U = allowable average direct stress in pounds per square inch (found only in the Thayer formula).

The following list includes the formulas most commonly quoted:

Cambria Steel Co., "Cambria Steel," 11th edition, 1914, for spans of 75 ft. or less.

$$T = 5SD$$

Carnegie Steel Co., "Pocket Companion," 19th edition, 1917, for loads of 40 lb. or more per square foot of ground area:

$$W = \frac{P}{40} \times \frac{1}{5}\left(\sqrt{S} + \frac{S}{8}\right)$$

Fowler, "Specifications for Steel Roofs and Buildings," 5th edition, 1909, for Fink trusses up to 200-ft. span:

$W = 0.06\ S + 0.6$ for heavy loads
$W = 0.04\ S + 0.4$ for light loads

Johnson, Bryan and Turneaure, "Modern Framed Structures," early editions: $W = S/25 + 4.0$. In the latest edition, 1916, the Ricker, 1907, formula is used for trusses resting on brick walls, and the Ketchum formula for trusses of steel-frame buildings.

Jones & Laughlin, "Standard Steel Construction," 1916:

$$W = \frac{P}{40}\left(\frac{S}{20} + \frac{12}{D}\right)$$

Ketchum, "Specifications for Steel-Frame Buildings," 3rd edition, 1916, for trusses up to 150-ft. span:

$$W = \frac{P}{45}\left(1 + \frac{S}{5\sqrt{D}}\right)$$

Maurer, "Cyclopedia of Civil Engineering," 1908:

$$W = S/25 + 1$$

Merriman, "Roofs and Bridges," 1888, 1911:

$$T = \frac{3}{4}DS\left(1 + \frac{S}{10}\right)$$

Ricker, "A Study of Roof Trusses," University of Illinois Bulletin, No. 16, August, 1907:

$$W = \frac{S}{25} + \frac{S^2}{6000}$$

Ricker, "Design and Construction of Roofs," 1912:

$$W = \frac{S}{25} + \frac{S^2}{12{,}600}$$

Thayer, "Structural Design," Vol. II, 1914:

$$T = \sqrt{\frac{PD}{U}}\,(4S^2 + 60S)$$

Trautwine, "Engineer's Pocket Book," 1911:

$$W = (0.05 \text{ to } 0.08)S$$

Tyrrell, "Mill Buildings," 1911, for roof load of 40 lb. per square foot of ground area, bays 10 to 20 ft., rafter slope 6 in. to 1 ft. and unit stresses of 12,000 compression, 15,000 tension:

$$W = \frac{S}{20} + \frac{12}{D}$$

The weights of trusses for other loadings and rafter slopes are obtained from a series of curves.

Conclusions regarding empirical formulas drawn from estimated weights of several hundred trusses may prove interesting. Three light Fink trusses resting on brick walls of 40-, 60- and 80-ft. spans, bays 16 ft., load equivalent to 40 lb. per square foot of horizontal area uniformly distributed on the top chord, roof slope 6 in. per foot, weighed 1370, 2550 and 4320 lb., respectively. The estimated weights of three trusses of the Warren type, same span and loading, but roof slope of 1 in. per foot, were 1500, 2900 and 4800 lb. The weights, according to the formulas quoted, for trusses with same spans and loading, are given in Table I.

TABLE I. WEIGHTS OF ROOF TRUSSES—16-FOOT BAYS; LOAD, 40 LB. PER SQUARE FOOT OF HORIZONTAL AREA
W = Weight per Square Foot of Area; T = Weight of Truss

Formula	40-Ft. Span		60-Ft. Span		80-Ft. Span	
	W	T	W	T	W	T
Cambria	5 00	3,200	5 00	4,800	5 00	6,400
Carnegie	2 26	1,446	3 05	2,928	3 79	4,851
Fowler	2 00	1,280	2 80	2,688	3 60	4,608
Johnson, B. & T.	5 60	3,584	6 40	6,144	7 20	9,216
Jones & Laughlin	2 75	1,760	3 75	3,600	4 75	6,080
Ketchum	2 67	1,709	3 56	3,417	4 44	5,683
Maurer	2 60	1,664	3 40	3,264	4 20	5,376
Merriman	3 75	2,400	5 25	5,040	6 75	8,640
Ricker, 1907	1 87	1,197	3 00	2,880	4 27	5,466
Ricker, 1912	1 73	1,107	2 68	2,573	3 71	4,749
Thayer	2 75	1,760	3 75	3,600	4 75	6,080
Trautwine	2 00	1,280	3 00	2,880	4 00	5,120
Tyrrell	2 75	1,760	3 75	3,600	4 75	6,080

Again, three Fink trusses of the same span, spacing and slope as before, but with load of 56 lb. per square foot of horizontal projection, an increase of 40%, weighed 1670, 3200 and 5500 lb., respectively. Trusses of the Warren type, roof slope of 1 in. to 1 ft., weighed 1900, 3750 and 6000 lb. The formulas give weights for this loading as in Table II.

The variation—in some cases more than 100 per cent.—of weights obtained from the different formulas will at once be noted. The values obtained from a number of the formulas depend upon the span length alone, and are the same for all loadings. Other formulas make the weight of the truss vary directly as the load, which actual weights show to be an error. DuBois, in "The Strains in Framed Structures," gives a formula taking

TABLE II. WEIGHTS OF ROOF TRUSSES—16-FOOT BAYS; LOAD, 56 LB. PER SQUARE FOOT OF HORIZONTAL AREA

W = Weight per Square Foot of Area; T = Weight of Truss

Formula	40-Ft. Span W	40-Ft. Span T	60-Ft. Span W	60-Ft. Span T	80-Ft. Span W	80-Ft. Span T
Cambria	5 00	3,200	5 00	4,800	5 00	6,400
Carnegie	3 16	2,024	4 27	4,100	5 31	6,791
Fowler	3 00	1,920	4 20	4,032	5 40	6,912
Johnson, P. & T.	5 60	3,584	6 40	6,144	7 20	9,216
Lukens & Laughlin	3 85	2,464	5 25	5,040	6 65	8,512
Ketchum	3 73	2,393	4 97	4,784	6 21	7,956
Maurer	2 60	1,664	3 40	3,264	4 20	5,376
Merriman	3 75	2,400	5 25	5,040	6 75	8,640
Ricker, 1907	1 87	1,197	3 00	2,880	4 27	5,465
Ricker, 1912	1 73	1,107	2 68	2,573	3 71	4,749
Thayer	3 26	2,082	4 44	4,259	5 62	7,193
Trautwine	2 60	1,664	3 90	3,744	5 20	6,656

into account the load, span, slope and unit stresses, but it is too cumbersome for use. Moreover, it supposes the chords to be of constant section, and neglects the web members, assuming that these two errors compensate.

In fact, as stated by Marburg, in "Framed Structures and Girders," the variables are so numerous that no formula, for the weights of roof trusses, which is at once simple, accurate and generally applicable, can be devised. Such a formula is not necessary. In calculating stresses the weight of the truss is usually so small compared with the weight of the covering, the snow and the wind, that an error in its assumption is negligible.

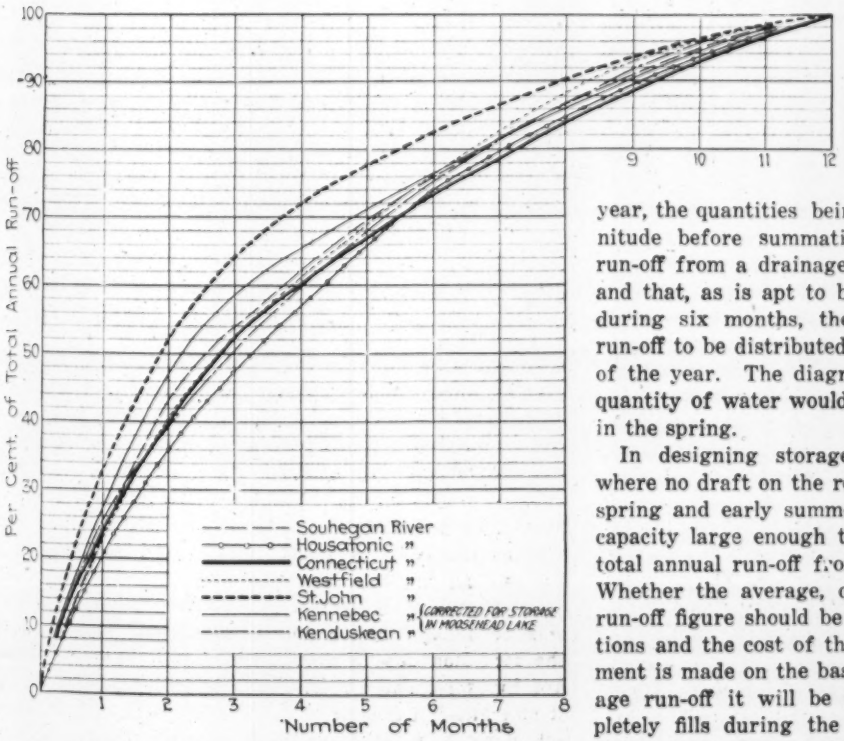
Ordinary steel roof trusses on brick walls with roof slope of 6 in. to 1 ft. and an assumed load of 800 lb. per linear foot of top chord, uniformly distributed, weigh from 30 to 75 lb. per linear foot of span for spans up to 85 ft. For less slopes the weight may be from 5 to 25% more. For different loadings the variation in weight is usually from 25 to 75% of the variation in loading. It should be noted that the personal equation of the designer and the many factors entering into the weights of roof trusses may cause a variation of 5 to 25% in the same truss.

New England Rivers Have Similar Run-Off Characteristics

In Seven Different Rivers Curves Show Half of Total Flow in Three Months and Three-Quarters in Six Months

IN THE analysis of flow records for rivers in various parts of New England the writer has found a marked similarity with respect to the quantity of water which runs off during a few months in the spring and its proportion of the total run-off for the year. The total quantity of water which passes down a river during any calendar month will naturally vary from year to year, and the month of highest run-off during one year may possibly be the month which ranks second or third highest for the next year. However, if records are available for several years so that definite conclusions can be drawn, it will be found that a certain month of the year stands preëminent as being the month which averages the highest run-off.

For the majority of New England rivers this month is April, although for some of the more northern streams May ranks the highest, and for a few rivers draining southern slopes March gives the highest run-off, the average for the one highest month being in the vicinity of 25% of the total run-off for the year. The total for the highest three months, which are usually consecutive, averages over 50% of the yearly total, while six months yield about 75% of the total. These figures are average figures based on several years' records in each case, and apply only to rivers where the flow is not regulated by the use of storage.



DISTRIBUTION OF RUN-OFF OF SEVEN NEW ENGLAND RIVERS IN A 12-MONTHS' PERIOD

The accompanying diagram shows how the cumulative run-off varies with different periods of time during the year, the quantities being arranged in order of magnitude before summation. Assuming that the total run-off from a drainage basin equals a depth of 24 in. and that, as is apt to be the case, 75% of this occurs during six months, there will remain only 6 in. of run-off to be distributed over the remaining six months of the year. The diagram shows that about the same quantity of water would go to waste during one month in the spring.

In designing storage reservoirs in New England where no draft on the reservoir is necessary during the spring and early summer, it is desirable to provide a capacity large enough to hold at least one-half of the total annual run-off from the tributary drainage area. Whether the average, or a greater than the average, run-off figure should be used depends upon local conditions and the cost of the development. If the development is made on the basis of storing one-half the average run-off it will be found that the reservoir completely fills during the spring months five years out of six, and also partially fills a second time in the autumn in some years.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Ready Reference Books for the Engineer

BY RUTH CANAVAN

Librarian with Metcalf & Eddy, Consulting Engineers, Boston

The accumulation of data and the verification of detail, by research, are necessary and important steps toward the solution of engineering problems. Certain of the most helpful reference works for these purposes are cited in the following paragraphs.

First, there may be mentioned the two useful compilations, "Engineering Index" and "Industrial Arts Index," the former covering the years 1884 to date, and the latter 1913 to date. "Engineering News Index" gives in even more minute detail than does the "Engineering Index" references to the articles in *Engineering News* from 1874 to 1909. [The period from 1910 to the close of March, 1917, when *Engineering News* was consolidated with *Engineering Record* will soon be covered by a volume now in press.—EDITOR.] The annual indexes to "Chemical Abstracts" (1907 to date) cover in a most comprehensive manner the literature on public health, sanitation, the industrial arts, water-supply and sewerage. A cumulative index of the annual indexes for the years 1907 to 1916 has recently been issued, and offers valuable assistance to the research worker.

Other useful cumulative indexes covering professional papers, committee reports and treatises, have been published by the American Society of Civil Engineers (1867 to 1911), the New England Water-Works Association (1882 to 1915), the Society of Chemical Industry (1896 to 1915), the American Society for Testing Materials (1898 to 1912), the American Institute of Electrical Engineers (1884-1910) and the American Institute of Mining Engineers (1871-1904, 1905-1909).

ENGINEERS' HANDBOOKS AND THEIR INDEXES

In seeking information from indexes the many professional "handbooks" must not be overlooked, for most of the compilers appreciate that the value of their books depends largely upon the adequacy of their indexes. For example, a fruitless search of several hours, through textbooks on solid geometry, failed to reveal the method for computing the cubical contents of a peculiar form of ungula; whereas reference to the index of Marks' "Mechanical Engineers' Handbook" led to a prompt solution of the problem. Other handbooks popular in the engineer's library are Merriman's "American Civil Engineers' Pocket Book," Trautwine's "Civil Engineer's Pocket-Book," Frye's "Civil Engineer's Pocket Book," Kidder's "Architects' and Builders' Pocket Book," Ketchum's "Structural Engineers' Handbook," "The Standard Handbook for Electrical Engineers," Foster's "Electrical Engineers' Pocket Book," Gillette's "Handbook of Cost Data," Dana's "Handbook of Construction Plant," Gillette and Dana's "Mechanical and Electrical Cost Data," Walker's "The Building Estimator's Reference Book," and Hool and Johnson's "Concrete Engineers' Handbook."

Many of these handbooks are copiously interlarded with references to articles and reports from which citations were derived, and help set the searcher on the right path. Some of the textbooks and scientific treatises offer similar guidance, by means of footnotes or appended bibliographies.

A card list of bibliographies, arranged alphabetically by subjects, is extremely helpful, and obviates the necessity of retracing ground once covered. Such a list may be so restricted as to include only the results of one's own searches, or amplified to include such bibliographies as those published by the Carnegie Institute, the Concrete Institute, and also those appended to treatises and textbooks.

USEFUL GOVERNMENT PUBLICATIONS

Of great value in engineering research are the publications of the various branches of the United States Government, such as the "Water-Supply Papers," the bulletins and "Professional Papers" of the Geological Survey; the reports and bulletins of the United States Public Health Service; and the contributions of the several bureaus of the Department of Agriculture. Then there are also the reports of the Army engineers and their "Professional Papers," the reports of the Coast and Geodetic Survey, the Lake Survey series, the Weather Bureau reports, the bulletins of the Census Bureau and the many-shelved publications of the Patent Office. Some of these branches issue departmental indexes, but all of the United States Government publications are listed in a "Catalog of the Public Documents of the (various) Congresses, and of all departments of the Government of the United States," issued monthly by the Superintendent of Documents and annually in cumulative form. A "Check List of United States Public Documents, 1789-1909," is also useful as a means of tracing publications that are not very recent.

GUIDES TO ENGINEERING BORDERLANDS

But it is perhaps in the border lands of the other sciences, only occasionally invaded by the engineer, that guidance is most welcome. Chemistry and bacteriology are, as he knows, quite thoroughly covered by "Chemical Abstracts," but a problem sometimes confronts him which demands for its solution a more intimate knowledge of the pathological significance of some factor than the familiar reference works afford, and he resorts to the medical library. Here he may consult "The National Standard Dispensatory" or the "Pharmacopœia of the United States" (two works issued in alternate years), Stedman's "Medical Dictionary," Thorpe's "Dictionary of Applied Chemistry," "A Reference Handbook of the Medical Sciences," an encyclopedia of medicine edited by A. H. Buck in eight volumes, 1885 to 1889.

or for references to the literature on medicine he may refer to the "Index Medicus" (published by the Carnegie Institute) or to the "Quarterly Cumulative Index to Current Medical Literature," published by the American Medical Association.

Again, if the engineer is called upon as an expert witness and wishes to fortify his testimony by references to court precedents, he seeks the law library where, if he wishes the Supreme Court decisions of the various states, he consults one of the branches of the National Reporter System (viz., "The Pacific Reporter," the "Northwestern Reporter," the "Northeastern Report," etc.), or he turns to the "American Digest," which undertakes to cover all decisions in all American courts. "Ruling Case Law" and "The Lawyers' Reports Annotated" also cover cases in all courts to a limited extent, by footnote references illustrative of the precedents enumerated. Textbooks and treatises such as Wait's "Engineering and Architectural Jurisprudence," are similarly helpful. The "Federal Reporter," however, covers only United States Circuit and District Court cases. All opinions relating to public utilities, whether delivered by state commissions or the courts of the various states, are digested in "Public Utilities Reports Annotated" which, unfortunately, only dates back to 1915. Then there are such general reference works as Black's "Law Dictionary," "Words and Phrases Judicially Defined" (an eight-volume encyclopedia), Stroud's "Judicial Dictionary" (in three volumes), Williams' "Law Dictionary" and Wharton's "Law Lexicon."

It sometimes happens also that the engineer is called upon to decide architectural details not usually falling within his province. Reference may then be had to Kidder's "Architects' and Builders' Pocket-Book," to the "Handbook for Architects and Builders," published each year by the Illinois Society of Architects, or to the files of such publications as the *Architectural Review*, the *Architectural Record*, *House and Garden*, etc., some of these publications being covered by the "Industrial Arts" and "Engineering" indexes, previously mentioned.

Finally, it is useful to know of such very general reference works as "The Readers' Guide," (1901 to date), "Poole's Index" (1882 to 1906), Bartlett's "Familiar Quotations," "The American Year Book," "The International Year Book," the "Biographical Congressional Directory" (1774 to 1911), "Who's Who in America," and "Who's Who in New England," etc.

While the reference works mentioned in the foregoing paragraphs are all well-known and much used, it is hoped that their enumeration may serve to recall some source of information which otherwise might be overlooked, or to give a timely suggestion to the baffled research worker.

Barge Canal Bulletin Ceases Publication

With the January, 1919, issue, the *Barge Canal Bulletin*, which has been published monthly for 11 years under the direction of the New York State Engineer and Surveyor, discontinued publication. According to Frank M. Williams, the present state engineer, the work on the Barge Canal is so nearly completed that it does not seem worth while to continue the publication of the bulletin, which gave publicity to the progress on the various contracts and other items of interest regarding the canal work.

Johnson's Great Book Rewritten

JOHNSON'S MATERIALS OF CONSTRUCTION. Rewritten by M. O. Withey, Associate Professor of Mechanics in the University of Wisconsin, and James Aston, Metallurgist with the A. M. Byers Co. of Pittsburgh. Edited by F. E. Turneaure, Dean of the College of Engineering of the University of Wisconsin. Fifth Edition. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth: 6 x 9 in.; pp. 829; illustrated. $6.

Those who have leaned for many years on J. B. Johnson's great book, "Materials of Construction," will study this new edition with interest and profit, and are likely to adopt it as their reference manual. It is a new work, yet it follows the spirit of the original on a modernized working basis. Such prominent features of the old Johnson as the elaborate descriptive discussion of the varieties of wood, for example, have disappeared, while a 200-page section on cements and concretes properly reflects the great advance in this field made in the 22 years since the appearance of the original work.

Under the editorial guidance of F. E. Turneaure, most of the book was written by M. O. Withey. Six chapters on iron and steel, covering the production of the metal and its constitution, were written largely by J. Aston. Fatigue of metals was handled by J. B. Kommers, and corrosion of iron and steel by O. P. Watts. This collaboration brought to bear on the work a notable wealth of ability and special knowledge. The book clearly reflects this fact; it is of high rank in balance of treatment, in judicious selection of test results and other data, and in critical judgment on the many doubtful or contentious points affecting the properties and testing of materials.

To summarize the contents very briefly: After an introductory section on applied mechanics, of 47 pages, there follow 90 pages on testing machines and testing procedure. An equal space is given to wood, and about 30 pages each to stone and clay products. Cement and concrete have 220 pages, of which 20 pages are devoted to natural cement and lime. Finally, a little less than 300 pages is given to metals, by far the larger part of this space being devoted to iron and its alloys. Cast iron has 40 pages, nonferrous metals 30 pages. The three short but important closing chapters are "Effects of Temperature on Mechanical Properties," 12 pages; "Fatigue of Metals," 16 pages, and "Corrosion of Metals," 18 pages.

Considering the inevitably great bulk of a work of this kind—not far from 1000 pages—and the great and ever extending range of subjects and questions concerned, the technical reader and user of professional works finds himself placed squarely before the question whether compendious treatises can hold their own with sets of specialist books, or whether they may not after all be the preferable thing. Clearly, the compendium must abstract, give boiled-down conclusions, and, in fact, must omit much. Yet there are many features of the present work that would support the argument for the treatise, in view of the excellence with which the work has been done.

It is well remembered that Johnson's original book possessed a strength based as much on his penetrat-

ing judgment of technical questions and discussions and his prophetic vision as on his genius for gathering and selecting data—remarkable as was this latter. This quality of judgment and vision, rare as it is, and necessarily an individual gift, has in a measure a parallel in the present work. True, the author's personality is not so characteristic of the new book as of the old. The times, of course, have changed, and it may be that a greater proportion of the subjective element would not have been wholly advantageous.

Two details of the book may be cited as bearing on the question—which, by the way, is a question to be decided by each prospective user of the book according to his mental leanings. Under the heading of the reason for the tensile test of cement, the book expresses itself very distinctly in advocacy of making the compression test the standard, and states that the reasons for adhering to the tensile test are inadequate. There is obvious conviction in the comment, and a serviceable reminder that conventional methods often lag. Rather different is the attitude of another page. In the treatment of fatigue of metals, after a descriptive review of endurance tests and their results, the text passes without comment to a statement of the use of fatigue formulas in fixing working stresses; it carefully refrains from correlating the tests at high stress ranges with service under low stress ranges. Thus it leaves untouched one of the most delicate and obscure questions in the field of steel structures.

Water-Works and Their Operation

REVIEWED BY CALEB MILLS SAVILLE
Manager and Chief Engineer of the Hartford Water-Works, Hartford, Conn.

CONVEYANCE AND DISTRIBUTION OF WATER FOR WATER Supply, Aqueducts, Pipe-Lines and Distributing Systems. A Practical Treatise for Water-Works Engineers and Superintendents—By Edward Wegmann, C. E., M. Am. Soc. C. E., American Water-Works Association, New England Water-Works Association. New York: D. Van Nostrand Co. Cloth; 6 x 9; pp. 663; illustrated. $5.

Within recent years most branches of engineering literature have received valuable contributions from authors well equipped in theory and practice. Water-supply, however, seems to have been somewhat neglected. This is particularly true of practical water-works operation, which has received little attention since the appearance in 1889 of that pioneer work, "Some Details of Water-Works Construction," by William R. Billings. A notable exception is the very complete "Water-Works Handbook," by Flinn, Weston and Bogert.

Mr. Wegmann's new book is timely. It is divided into three parts: (1) Water Consumption and Hydraulic Formulas (54 pp.); (2) Design and Construction (436 pp.); (3) Maintenance and Operation (143 pp.). In addition, there are five appendixes, three of which are devoted to standard specifications for water pipes, valves and hydrants, structural and boiler steel. Following, there is a brief description of inside fire-protection systems and a reprint of the fire stream tables of the National Board of Fire Underwriters.

The first chapter is principally devoted to data on consumption and waste of water in municipalities. The next two chapters treat very briefly of the hydraulics of water-supply pipes and conduits, and are apparently intended merely for reference. The four chapters on pipes of wood, cast-iron, steel, cement and concrete contain little or no discussion of the merits of the several materials, their applicability to special conditions or their behavior under service conditions. Brief attention is given to stress in pipes due to water pressure, water hammer and temperature. The collapse of empty steel pipes is mentioned. Little is said of stress due to backfill or the care necessary in laying large pipes of comparatively brittle material.

Two chapters on submerged pipes give general descriptions of several under-water pipe crossings. In the two following chapters a number of makes of gate valves, sluice gates, pressure regulators and hydrants are illustrated and described. A discussion of the merits of the several types mentioned, without makers' names, would have added greatly to the value of the book.

The four chapters on intakes, tunnels, aqueducts and service reservoirs, are mostly descriptive and chiefly of historical value, giving little detailed information on design, construction or cost. They appear to have been compiled from reports and technical papers. The several aqueducts of the New York City water-supply are described in considerable detail, and much of the information appearing in the annual reports of the Croton Aqueduct and the Board of Water-Supply is brought together in convenient shape for reference.

In the chapter on service reservoirs, tables of cost of covered reservoirs are given. As these tables were compiled about 20 years ago by Freeman C. Coffin, some caution should be attached to their use at the present time. A very comprehensive compilation of groined-arch data by Prof. John H. Gregory is valuable for use in connection with that kind of construction. The pages given to reinforced-concrete stand-pipe construction are descriptive of many structures which have been built, and a very excellent table is given of the principal data connected therewith.

Tanks of wood and steel are described and some information is given as to design. Under fire protection, classic data are presented regarding the number and size of fire streams required, experiments of discharge and loss of head in fire hose, and a description of the method of conducting flow tests of hydrants. There are good descriptions of the high-pressure water systems in New York, Philadelphia, Baltimore and San Francisco.

Part II closes with seven pages on the various kinds of distribution systems; they give little information as to details and methods required in laying out the work.

Part III is devoted to general descriptions of water-works maintenance appurtenances and appliances. Some brief statements concerning electrolysis, abstracted mainly from reports of the late Prof. A. F. Ganz, are given. Tools and machinery used in pipe work and methods and apparatus used in waste and leakage surveys of water-works systems are next treated. Full descriptions of the various types and makes of meters in use occupy 64 pages. Mention is made of testing apparatus which is furnished by different makers, and a brief discussion is offered regarding results to be obtained. A very interesting and instructive diagram is given as to the average accuracy of ⅝-in. disc meters both new and after service. The author fails to state the conditions under which the data for constructing the curves were obtained.

The last chapter describes various instruments for

recording the height of water in reservoirs, stand-pipes and streams. Most of the standard devices are mentioned.

The book makes some mention of almost every matter connected with water-works operation. The portion on hydraulics is rather too brief for the hydraulic engineer and perhaps not sufficiently elementary for the nontechnical superintendent.

The chapters on design and construction are mostly historical or descriptive. They contain much matter gleaned from published reports on large work and from papers which have appeared from time to time in the technical press and in society transactions.

The portion of the book devoted to maintenance and operation, and especially those parts dealing with appurtenances, seem to be mainly a compendium of information contained in trade publications and advertising literature, rather than an original and distinct contribution to engineering knowledge.

While the classical work of Dexter Brackett, in his water-waste report to the Metropolitan Water Board of Massachusetts in 1903, is well and justly recognized by the author, it is to be regretted that he did not also include mention of the truly remarkable results attained in curtailing waste in this same district which recently has come about principally through the introduction of meters.

The descriptions of water-works appurtenances might well have been supplemented by discussions of the fundamentals of the different types of apparatus and of the limitations of the appliances under certain conditions. This would be of use to water-works engineers and superintendents and would enable them to separate more quickly the grain from the chaff in the salesman's argument.

The author deserves praise for enriching a rather barren field of engineering literature. Water-works superintendents and engineers should be thankful to him for bringing together in one place information concerning so many water-works devices and methods.

For Instructors of Industrial Workers

THE INSTRUCTOR—THE MAN AND THE JOB: A Hand Book for Instructors of Industrial and Vocational Subjects—By Charles R. Allen, Sometime Agent for Industrial Training for Boys and Men, Massachusetts Board of Education, and Superintendent of Instructor Training, U. S. Shipping Board, Emergency Fleet Corporation. Philadelphia and London: J. B. Lippincott Co. Cloth; 5 x 8 in.; pp. 373. $1.50.

According to C. A. Prosser, who in the Introduction states that he is well acquainted with the author, this book is the most important contribution yet made to industrial and trade training. It deals with the vital problem of the selection and training of competent instructors, and it should give employers and foremen a clear and accurate conception of the needs and possibilities of training new workers. It demonstrates that the pedagogy of industrial education has built up a definite content for courses of its own.

The author states that his main purposes are to present a handbook to instructors in industrial plants, and furnish instruction notes for instructor-training courses. The book is the result of actual experience in training over 1000 shipyard instructors. A fairly complete idea of the contents is given by the titles of the nine parts into which the book is divided: Training in the Plant; the Analysis and Classification of Trade Knowledge; Establishing an Effective Instructional Order; Putting it Over; Methods of Instruction; Lesson Planning; Instructional Management; Organization for Training in Industry; The Use of This Material in Instructor-Training Courses.

Perhaps the essence of the author's ideas can be expressed in his concept of what instruction really is, and his proposed tests of effective instruction. He maintains that telling is not instruction, drilling is not instruction, and showing is not instructing. In every case, true instruction requires thoughtful action on the part of the learner.

The book will be not alone of great practical value to vocational instructors, but also unusually suggestive for teachers of engineering in our colleges and universities, in view of the desire to profit by the war experience which is seen in many institutions.

Sewage Disposal Brought Up to Date

SEWAGE DISPOSAL—By Leonard P. Kinnicutt, late Director Department of Chemistry, and Professor of Sanitary Chemistry in the Worcester Polytechnic Institute; C.-E. A. Winslow, Professor of Public Health in the Yale School of Medicine and Curator of Public Health in the American Museum of Natural History, New York, and R. Winthrop Pratt, Consulting Engineer, M. Am. Soc. C. E. Second Edition, Rewritten. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 547; illustrated. $4.

The present thorough revision is timely, now that a resumption of building sewage-treatment works may be expected after a suspension of activities due to the war. Moreover, the subject is so complex and so many new processes, or variations and changes in old ones, are being continually made, that any book on sewage disposal soon gets out of date. The book first appeared in 1910 and was reviewed at length in this section of *Engineering News* of Nov. 17, 1910, p. 42 of the Engineering Literature Supplement, and also in *Engineering Record* of Nov. 19, 1910, p. 591.

The principal topics which have been expanded or added in the present edition are: Data on disposal by dilution, with particular reference to the investigation and conclusions of the International Joint Commission in its studies of the pollution of the Great Lakes; fine screening, notably experimental and other installations of Riensch-Wurl screens; the present status of Imhoff tanks, with special regard to foaming and related difficulties that have led some engineers to turn away from these tanks of late; the activated-sludge and the Miles-acid processes, both of which have come to the front since the first edition of this book appeared.

The book as a whole is a well-rounded presentation of the development and present status of sewage disposal.

Industrial Democracy Illustrated

MAN TO MAN: The Story of Industrial Democracy—By John Leitch. New York: B. C. Forbes Co. Cloth; 5 x 8 in.; pp. 249. $2.

So much has been written about industrial democracy in general terms that concrete examples afford a pleasing contrast. In this readable volume the author tells how he has helped to establish a number of manufacturing plants on the basis of a community of interest between employers and employees, substituting good-will for ill-will, and coöperation in production and profit for opposing class interests. In brief, the plan is to form a system of industrial government similar to our own Federal Government, with the wage earners as a lower house—all of them in small plants, and representatives in large plants. The Senate is composed of "under-executives, department heads and subforemen, accord-

ing to the size of the establishment." The cabinet consists of the executive officers of the company, with the president of the company acting as chairman.

In place of profit-sharing as commonly practiced, which the author apparently regards as a more or less arbitrary bonus system, the author has introduced at a number of plants a wage increment based "on the efficiency of production." He says: "I take the cost of a unit of production in the period preceding the introduction of industrial democracy and compare that cost with the results after democracy has gone into effect. The gain is distributed as a "collective economy dividend," half to the employees and half to the proprietors. It is paid at frequent intervals, as every two weeks, so as to make it a constantly live issue.

Text on Strength of Materials

REVIEWED BY CLYDE T. MORRIS
Civil Engineering Department, Ohio State University, Columbus, Ohio

APPLIED MECHANICS—By Charles E. Fuller, S. B., and William A. Johnston, S. B., Professors of Theoretical and Applied Mechanics, Massachusetts Institute of Technology. Vol. II.; Strength of Materials. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 556; illustrated. $3.75 net postpaid.

Considering the fact that very little space is devoted to discussion of tests or the physical properties of materials of engineering, and that centers of gravity and moments of inertia are not included, this volume of 556 pages seems unnecessarily large. In part this is due to the inclusion, at the end of each chapter, of a large number of illustrative problems, which are generally most excellent. The methods of the calculus have been employed throughout, perhaps to a greater extent than is customary, and mathematical refinements of theoretical calculation of stresses are given which are sometimes unwarranted by the assumptions made in the premises as to the properties of the materials and the conditions met with in structures. It should be noted that the authors state in the preface, "As preparation the student should have a knowledge of differential and integral calculus, the principles of statics and dynamics, and the methods of determining the centers of gravity and moments of inertia of areas and solids."

The first chapter is devoted to a discussion of the physical properties of materials, but very little is given on the results of tests. It is followed by a chapter on analysis of stress and strain, a theoretical discussion of the relations of stress intensities acting on a particle in various directions, and including the ellipse of stress. Chapters on uniform stress and uniformly varying stress and stresses in beams give the ordinary theory of flexure. In the discussion of riveted joints no mention is made of the fact that in a riveted joint the friction is the principal resisting medium and that in good work the frictional resistance between the plates is seldom overcome. The chapter on the general theory of flexure includes beams with unsymmetrical cross-sections, acted upon by oblique loads.

Combined stresses, Chapter VII, might better be discussed after Chapter IX, on columns, and should include the article in that chapter which treats of the strut or tie subjected to combined axial and lateral loading. The treatment in Chapter VII is only approximate, neglecting the effect of the deflection of the member, and might be omitted without loss.

In the chapter on arches and catenaries, after giving the equations for the reactions of arches with two hinges and without hinges, expressed in the form of integrals, the authors develop at great length the reactions for arches of uniform cross-section in which the axis is the arc of a circle. This may be good mental gymnastics for the student, but as these conditions are almost never met with in practice, and seldom attempted, it seems that the work would have been much more valuable if the axis had been made parabolic and the section variable, as in the usual case.

The last chapter, treating of reinforced-concrete beams and columns, contains the derivation of the usual formulas for simple beams, T-beams and columns, based on the straight-line assumption. The system of notation is fairly uniform throughout and conforms in the main to current usage. It would be a great help in using the book as a reference if a table of notation were given to obviate the necessity of searching through the text for the meaning of a letter or symbol.

As a textbook for class instruction, this new work may be satisfactory if supplemented with data and lectures on tests of materials, but as a reference book for the practicing engineer it does not promise to be of any great value.

The Manufacture and Cost of Liquid Steel

LIQUID STEEL: Its Manufacture and Cost—By David Carnegie, F. R. S. E., M. Inst. C. E., M. I. Mech. E., M. I. S. Inst.; Assisted by Sidney C. Gladwyn, Wh. Ex., A. M. Inst. C. E. (Bayliss Prizeman). Second Edition. New York and London: Longmans, Green and Co. Cloth; 6 x 9 in.; pp. 526; with 10 plates and 252 illustrations. $10.

This second edition of the work of a Canadian author, the first edition of which was reviewed in *Engineering News* of Aug. 8, 1913, p. 328, is unchanged except for the addition of five pages on the development of electric steel manufacture in Canada. The new matter consists of a tabular list of the electric furnaces in Canada, which were used, before the war and in 1917, mainly in the manufacture of steel for ingots or steel castings or low phosphorus pig iron. A list of companies manufacturing ferro-alloys and electrodes is added, and a typical charge for shell steel with a statement of electrode consumption concludes the new chapter.

Extending Our Foreign Trade

AMERICAN METHODS IN FOREIGN TRADE: A Guide to Export Selling Policy—By George C. Vedder. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co. Ltd. Cloth; 5 x 8 in.; pp. 204.

The extension of American contracting and industrial business into all parts of the world has created a demand for information regarding the best methods of conducting our foreign trade. Among other broad subjects the author of this book discusses the trade policies of the principal nations of the world; the Webb-Pomerene Act and combinations in foreign trade, and a variety of export problems and details, including agents, catalogs, "Heavy Machinery in Foreign Markets," "American Banks Abroad," our merchant marine, "America's Preëminence in Salesmanship," and our tariff in relation to foreign trade.

An Omission Noted

By mischance the name of George Paaswall, New York City, was omitted as the reviewer of Dozal's "Retaining Walls," in our issue of Feb. 20, 1919, p. 390

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

THE CEMENT GUN: Its Application and Uses—By Bryan C. Collier, M. Am. Soc. C. E. Reprint from Paper Read before the Municipal Engineers of the City of New York, Dec. 23, 1918. Allentown, Penn.: Cement Gun Co., Inc. Paper; 6 x 9 in.; pp. 21; illustrated.

CEMENT IN 1917—By Ernest F. Burchard; with a Section on Concrete Ships by Robert W. Lesley. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 37; illustrated.

CHLORINATION OF WATER—By Joseph Race, F. I. C., City Bacteriologist and Chemist, Ottawa; Captain Canadian Army Hydrological Corps; Member of Committee Standard Methods of Analysis, American Water-Works Association. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 158; illustrated. $1.50.

COMPRESSED AIR PLANT: The Production, Transmission and Use of Compressed Air, with Special Reference to Mine Service—By Robert Peele, Mining Engineer and Professor of Mining in the School of Mines, Columbia University. Third Edition, Largely Rewritten. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 485; illustrated. $4.25.

In this edition some chapters "have been entirely rewritten and several have been expanded," the preface states, but the size of the volume has been kept down "by condensation and omission of old matter." The first edition, entitled "Compressed Air Plant for Mines," was reviewed favorably in *Engineering News* of Sept. 17, 1908, the second edition in *Engineering News* of Jan. 19, 1911. The book is divided into two parts; (1) Production and (2) transmission and use of compressed air. Under "Use," rock and hammer drills, coal-cutting and channeling machines, mine pumps and mine haulage and the air-lift pump are described.

DESCRIPTION OF AND GUIDE TO JASPER PARK—Ottawa, Can.: Department of the Interior. Cloth; 7 x 10 in.; pp. 97; illustrated.

Based on a photographic survey by M. P. Bridgland, Dominion land surveyor. Contains handsome halftones, descriptive text and historical notes, all edited by E. Deville, surveyor general of Canada. The park is located in Alberta.

DRAFTING ROOM METHODS, STANDARDS AND FORMS. A Reference Book for Engineering Offices and Draftsmen—By Charles D. Collins, M. Am. Soc. C. E. New York: D. Van Nostrand Co., Cloth; 6 x 9 in.; pp. 149; illustrated. $2.

Notes on drafting-room organization, arrangements; drafting standards, symbols, abbreviations; drawing sizes and methods of marking and filing drawings. Contains also miscellaneous tables of use to mechanical engineers, conversion tables for metric system, weights and measures, decimal equivalents, etc.

DRAINAGE METHODS AND FOUNDATIONS FOR COUNTY ROADS—By E. W. James, General Inspector, Vernon M. Peirce, Assistant Engineer, Charles H. Moorefield, Senior Highway Engineer. Washington, D. C.: U. S. Department of Agriculture, Bulletin No. 724. Paper; 6 x 9 in.; pp. 86; illustrated. 20c. from Superintendent of Documents.

Covers soils, design of ditches and gutters, subdrainage, foundations, loads which can be carried, etc. Contains runoff tables for the capacity of various kinds of drains, and costs of drains and foundations. It should be interesting to all highway designing engineers.

IMPROVEMENT OF THE UPPER MISSISSIPPI RIVER: A Bibliography—By Miss Winifred Gregory, Chief of the Industrial Arts Division, of the St. Paul Public Library. St. Paul, Minn.: Affiliated Engineers' Societies of Minnesota. Paper; 6 x 9 in.; pp. 22.

MANUAL OF INSPECTION AND INFORMATION FOR WEIGHTS AND MEASURES OFFICIALS—By F. S. Holbrook, Inspector of Weights and Measures, Bureau of Standards, Washington, D. C.: Bureau of Standards. Cardboard; 5 x 7 in.; pp. 246; illustrated. Free on request.

MICHIGAN STATE HIGHWAY COMMISSIONER: Seventh Biennial Report, for Two Years Ending June 30, 1918. Lansing, Mich.: State Highway Department. Cloth; 6 x 9 in.; pp. 142; illustrated.

MNEMONIC NOTATION FOR ENGINEERING FORMULAE: Report of the Science Committee of the Concrete Institute; with Explanatory Notes by E. Flander Etchells. New York: Spon & Chamberlain. London: E. & F. N. Spon, Ltd. Cloth; 6 x 9 in.; pp. 116; illustrated. $2.50.

Radical changes in algebraic symbols and related elements of formula language are proposed in this report. The "mnemonic" feature is illustrated by the author's advocacy of *B* for bending moment. Some of the innovations are of typographical nature and call for unusual fonts of type. Others are the substitution of new letters for quantity symbols now commonly used. The report has a number of appendixes, of which one, entitled "The Inter-Relationship of Nomenology and Symbology," indicates the author's viewpoint. Incidentally, the word "milai" is used as the name of the 1000-lb. unit.

MODEL MAKING: Including Workshop Practice, Design and Construction of Models; A Practical Treatise for the Amateur and Professional Mechanic, Giving Instructions on the Various Processes and Operations Involved in Model Making and the Actual Construction of Numerous Models, Including Steam Engines, Speed Boats, Guns, Locomotives, Cranes, etc. Edited by Raymond Francis Yates, Editor of Everyday Engineering Magazine. New York: The Norman W. Henley Publishing Co. Cloth; 6 x 9 in.; pp. 390; illustrated. $3.

A book for boys and men, this little work is likely to prove inspiring, helpful and instructive. Preliminary to the description of the making of various special models—of engines, hoists, boilers, boats, locomotives, and the like—there are very good chapters on the right kind of workshop, on lathes and drills, on soldering, on hardening and tempering, on the use of abrasives, and on pattern making and electroplating.

MUNICIPAL FINANCES: Report, Mar. 31, 1918; Statistics of Cities and Towns of Iowa. Frank S. Shaw, Auditor of State. Des Moines, Iowa: State Auditor. Cloth, 6 x 9 in., pp. 294.

Among the tables of particular interest to municipal engineers is one giving the salaries of department heads in Iowa cities and towns. The report covers all the 105 cities of the state and 719 of the 789 towns listed.

THE NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES: A Permanent Association of Organizations in the Construction Industries and Professions, Succeeding the Temporary Organization Formed July 15, 1918, under the Auspices of the Chamber of Commerce of the United States of America. Philadelphia, Penn.: The Federation. Paper; 8 x 11 in.; pp. 23.

NEW HAMPSHIRE STATE HIGHWAY DEPARTMENT. Seventh Biennial Report Relative to Highway Improvement. Concord, N. H.: The Department. Paper; 6 x 9 in.; pp. 214; illustrated.

NOTE ON VARIOUS TYPES OF EXTENSOMETERS FOR TESTING BRIDGE GIRDERS—By H. S. Sales. Simla, India: Railway Board of India. Paper; 8 x 13 in.; pp. 16; illustrated.

PEARSON'S PATENT PERMANENT WAY—By J. D. Pearson, B.A., B.E., M. Inst. C. E., Executive Engineer, B., B. & C.I. Ry. Simla, India: Railway Board of India. Paper; 8 x 13 in.; pp. 4; illustrated.

Ties are dispensed with, each rail being riveted or bolted to a flat longitudinal plate 12 in. wide. Gage is maintained by tie bars. A 400-ft. length of this track has been laid.

A PLAN FOR SHOP SAFETY, SANITATION AND HEALTH ORGANIZATION—Issued Under the Direction of the Industrial Commission, John Mitchell, chairman. Albany, N. Y.: New York State Department of Labor. Paper; 6 x 9 in.; pp. 32.

A PORTABLE CUBIC-FOOT STANDARD FOR GAS—By M. D. Stillman, Assistant Physicist, Bureau of Standards. Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 13; illustrated. Free on request.

PROBLEM OF RECONSTRUCTION WITH RESPECT TO URBAN TRANSPORTATION—By Delos F. Wilcox, Ph.D. Reprinted from *National Municipal Review*, January, 1919. Elmhurst, New York City: The Author. Paper; 7 x 10 in., pp. 15.

THE RELATIVE CORROSION OF CAST-IRON, WROUGHT-IRON AND STEEL PIPE IN HOUSE-DRAINAGE SYSTEMS—By William Paul Gerhard, M. Am. Soc. M. E. New York: The Author, 736 W. 181st St. Paper; 6 x 9 in.; pp. 34; illustrated. 34c., postpaid.

REPORT ON THE BEST PROCESS AND PLANT FOR TREATING RAILWAY SLEEPERS—By C. D. Dove Wilson. Simla, India: Railway Board of India. Paper; 8 x 13 in.; pp. 12; illustrated.

This deals only with English practice in creosoting ties, including the full-cell process, the Ruping empty-cell process and the Boulton boiling process.

RHODE ISLAND STATE BOARD OF PUBLIC ROADS: Seventeenth Annual Report. Providence, R. I. Paper; 6 x 9 in.; pp. 79; illustrated.

SANITATION IN EMERGENCY SHIPYARDS—By W. L. Stevenson, Late Sanitary Engineer, Department of Health and Sanitation, U. S. Shipping Board, Emergency Fleet Corporation. Reprinted from the *Journal* of the Boston Society of Civil Engineers, January, 1919. Address the author, care Pennsylvania State Department of Health, Harrisburg, Penn. Paper; 6 x 9 in.; pp. 18; illustrated.

SPECIAL WATER POWER INVESTIGATION, STATE OF MAINE, 1918. Augusta, Me.: Public Utilities Commission. Paper; 6 x 9 in.; pp. 420; illustrated.

STEAM ENGINE TROUBLES: A Practical Treatise for the Engineer, Telling How to Locate and Remedy Troubles with a Steam Engine—By H. Hamkens, Mechanical Engineer. New York: The Norman W. Henley Publishing Co. Cloth; 5 x 8 in.; pp. 284; illustrated. $2.50.

A revision and extension of a series of articles originally published in *Power*.

STRUCTURAL STEEL FOR SHIPS: Standard Practice Recommended by American Steel Makers as Adopted by the Emergency Fleet Corporation. Revised Nov. 20, 1918. Pittsburgh, Penn.; Carnegie Steel Co. Paper; 5 x 8 in.; pp. 60; illustrated.

THE SUDD REGION OF THE WHITE NILE AND THE HARNESSING OF ITS WATERS—By Sir William Willcocks, K.C.M.G., Late Director General of Reservoir Projects, Cairo, and Director General of Irrigation Projects, Bagdad, and John Wells, Consulting Engineer and Managing Engineer Egyptian Government Research Work. Cairo, Egypt: The Authors. Paper; 7 x 10 in.; pp. 30; illustrated.

WATER CONSERVATION AND IRRIGATION COMMISSION REPORT, NEW SOUTH WALES, 1918. Sydney, Australia: The Commission. Paper; 8 x 13 in.; pp. 29.

WISCONSIN HIGHWAY COMMISSION: Fourth Biennial Report Showing State-Aid Highway Operations, 1916-18. Madison, Wis.: The Commission. Paper; 6 x 9 in.; pp. 358; illustrated.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Return Highway Engineers from France

Sir—You are probably familiar with the literature and advertising which were sent out in the recruiting of the 23rd Engineers. It was represented that this regiment was to be a special road-building regiment made up of experienced construction men—engineers, contractors, superintendents, and all classes of experienced men doing this work.

This regiment probably did a great deal of good work in France, during the year preceding the signing of the armistice. I feel now that it is needed here in the United States more than it is in France. I had a letter from my brother who is in the regiment, written Jan. 27, saying that they were building macadam roads in France on that date, and had been since the armistice was signed.

I do not believe it fair or honest to the members of this regiment to keep them there any longer. Some of the boys who were getting from $150 to $200 per month as foremen and superintendents are working over there with picks and shovels at $33 per month. They were willing and anxious to make this sacrifice during the prosecution of the war, but now that it is over I do not believe that they are willing to do this work, but are anxious to get back here, and I know that we need them. Is there not some way that we can get this regiment returned home?

The Government is urging the building of roads, pavements and buildings, and construction of all kinds, and there is going to be a great amount of this class of work started this month. The 5300 members of the 23rd Engineers, being experienced men, should be here now to take advantage of the opportunities that are opening up. J. K. SHINN.

Independence, Kan.

Injustice to Engineers Returning from Army

Sir—I beg leave to air a grouch against the engineering profession. From time to time you have printed articles regarding the underpaid younger members of the profession, but there is still a lot left unsaid.

Take, for instance, the case of the young engineers with a college education and a few years' experience who have joined the colors. Some entered engineer training camps, others enlisted in engineer regiments, and quite a few, desiring a more personal method of getting at the Hun, entered the line. For the majority of these men, their engineering education proved almost a passport to a commission, and for once at least the value of engineering training was considered at its true worth.

These men, many of whom were employed on construction work long since completed, now stand on the verge of demobilization, and few of them have their former positions open to them. Naturally, most of those who are seeking employment turn their efforts first toward the field of their profession; but what do they find? If there is any demand at all for their services, they are offered positions involving considerable responsibility at the same wage (or less) than a day laborer can demand.

Discouraged, the thought is bound to sink home: "Just what is the incentive to take up their profession where they left off?" Why should a man, well educated and reared in a comfortable home, give up almost everything in life that he has learned to consider worth while, and the best years of his life, to an existence comprised of construction camps and cheap boarding houses, deprived of the society of intellectual equals other than his companions in exile, as many of us have experienced, at less salary than that of a labor foreman in charge of a dozen or so foreign laborers? Why should a man who has spent four years or more at college be unable to demand as much pay as a man who has served an apprenticeship as a plumber, boilermaker, or the like? Take the more intimate side of his life—a man's thoughts usually turn to marriage sooner or later—can an engineer marry a girl of his own station in life, accustomed to the comforts of home and perhaps a few of the luxuries of life, and hope for real happiness with several years of bitter struggle and hand-to-mouth existence ahead? Ought he not be given some slight recompense in the way of salary for the lack of opportunity to establish a home?

The profession blames the public for failure to recognize the engineer's true value; but is the public altogether to blame? Isn't it largely the fault of the engineers themselves? Why should anyone be willing to pay the engineer in charge a fair salary when he himself hires an efficient assistant, often as good as himself, at a mere pittance, and so on down the line? It seems to me that if engineers would quit blaming the public for lack of recognition of their worth, and each and every one would try to get those under him an increase in pay commensurate with their ability, it would soon raise the scale of wages of the whole profession. A. H. ARMSTRONG,

First Lieutenant, United States Marine Corps.

Marine Barracks, Quantico, Va.

Federation of American Engineering Societies Proposed

Sir—The question of consolidation of the engineering profession in America, ordinarily one of importance, has been brought to a head by the war and the reconstruction following it, and there is at the present time much comment upon the activities and policies of the engineering societies which are depended upon to effect the consolidation. The main object is, of course, the public recognition of the engineer, which the engineer feels has not been forthcoming so far, but which he thinks could be materially furthered by the consolidation.

There was a time when the doctors were not recognized any more than the engineers are now, but, thanks

mainly to the effective work of the American Medical Association, that condition is now past, whilst the profession's interests are guarded by a powerful organization, irrespective of whether its members are graduates of a particular university, or of a college of physicians or one of surgeons. Can this be duplicated in the engineering profession?

Influential engineers seriously considering this matter would like to see some kind of a federation of the engineering societies, with some such body as a general engineering board of direction at the head and representative of all. They would like to see a plan put through whereby each qualified engineer would be enrolled as a member of one huge organization, controlled and administered by such a board. Such a development in engineering organizations is a sweeping one, and there is very little sight of it "up the pike" so far.

Who has the scheme which will effectually coördinate all professional engineers, however specialized, and yet exclude all who are deemed insufficiently qualified, and which will not restrict the main activities of the engineering institutions but will embrace them all? Who would like to suggest a democratic Federation of American Engineering Societies?

Who, having suggested such a federation, wants to differentiate the existing organizations so that they may be assigned to their proper places in it? If this much could be worked up as a starter—just to see where we should arrive—and some publicity given to the results, then it might serve to help in many ways. In the first place, new societies might stop long enough in the framing of their charters to consider where they would stand and what little reservation they would fill out in such a federation; this might tend to reduce the number of organizations—a good thing if such reduction means simplification and tends toward better organization and control. In the second place, the older organizations who have, without exception, endeavored to "spread themselves all over the map" might also stop to consider whether "safeguarding the interests of the engineer" can be taken care of by the same organization and the same set of workers in it (for there is always a set of workers) as advance the purely educational side of the profession. In other words—none of which is meant in criticism—the organizations would begin to consider how they could all hold one another's hands without stepping on one another's toes.

All concerned would then probably arrive at an opinion that such bodies as the educational and technical societies—admirable as such—cannot properly take up economic matters concerning the financial position of their members; that such bodies as the local engineering societies should get in on the ground floor in the advancement of public affairs in state or community, and that the federation might try its hand at the national affairs.

The problem is a big one—the biggest the organizations have to face—and if a solution is attempted some organizations will stay up and some will go down. Responsible engineers would say, however, that the attempt is worth while if it only succeeds in inaugurating a legitimate movement which has the goodwill of the majority, and in which all honest organizations can fearlessly participate in the endeavor to create something for the good of all. Such a movement has not yet appeared, although some think they see it in the Engineering Council—which is no criticism of the Engineering Council. The council from the start has, however, represented the few and not the many—there are now five organizations in it out of possibly one or two hundred organizations that are eligible. Its work is being done in good faith; but the large number of societies not yet included, and not provided for in the charter of the council at the outset, would say that the organization, not representing them, is undemocratic. Whether it is or not, they would say it isn't, and so what is the use?

Mr. Flinn, secretary of the council, speaking recently at a general meeting of Canadian engineers, said that for evident reasons it would be impracticable for the Engineering Institute (of Canada) to become a member of the Engineering Council on the same basis as the other five societies, but international coöperation would be desirable, and he would suggest that the Engineering Institute and the Engineering Council should appoint a committee (another committee!) for interchange of good-fellowship and for active coöperation.

Better, then, regard the Engineering Council as what it is—a committee, a joint committee of the four national engineering societies known as the Founder Societies and one or two others, with a program of activities suggested by the participation of engineers in public affairs. It is not, and cannot become, unless its constitution is radically changed, an organization to represent all engineers, which is what we want.

The Engineering Council is apparently the only thing of its kind now existing in this country, and is the only coöperative movement representing a number of the engineering organizations—and, incidentally, it does represent probably 30,000 or 40,000 engineers. But the point is, it does not represent the organized engineering profession. These statements are not in criticism of it, but are merely to show that in this movement there is no sign of such a thing as a Federation of American Engineering Societies would perhaps provide.

WILLIAM E. BULLOCK.
Assistant Secretary, American Society
of Mechanical Engineers.
New York.

Giving Credit Where Credit Is Due

Sir—In your issue of Feb. 20, 1919, p. 394, is a letter from C. E. Drayer, secretary of the American Association of Engineers, in which, among other things, he says "the efforts of the American Association to raise the pay of the technical engineer in railroad employ have been successful, much beyond early hopes." This is very encouraging and is fine work, but is the A.A.E. justified in taking all the credit to itself, as is implied by the tone of Mr. Drayer's remarks?

When it was found that the Railroad Administration had overlooked the technical engineer in the matter of increased compensation, both the A.A.E. and the Engineering Council brought the question to the attention of the administration, with the request that justice be done. Now, the Engineering Council represents six national technical organizations, with a combined membership of about 40,000 engineers, and the life history of the oldest of these member societies dates back nearly 70 years. The A.A.E., on the other hand, represents barely 3000 engineers and the years of its

life can be counted on the fingers of one hand. It is a fair question to ask, therefore, which of the two communications carried more weight with the Railroad Administration?

I am thoroughly in sympathy with the aims and work of the A.A.E. It has accomplished wonders in a short time. There seems to be a tendency among its officers and members, however, to claim for the association rather too much of the credit for results obtained, and at the expense of the old founder societies. In fact, the latter are usually ignored or destructively criticized. This attitude I have noticed in the official organ, *The Monad*, and in individual members of my acquaintance. Does this not appear to be a wrong attitude to take? Does it not tend toward bad feeling and disintegration, rather than toward enthusiasm and coöperation in the profession? The latter condition is an avowed aim of the A.A.E., I believe. Again, such an attitude is not warranted in view of the fine results recently achieved by that offspring of the founder societies, namely, the Engineering Council.

Granted that the founder societies needed prodding and awakening, and that they have been asleep to many of their opportunities and responsibilities; granted, too, that the A.A.E. was instrumental in the work of revival, still, the most unsparing critics and the most vehement prodders have been and are, themselves, members of these identical societies. So the A.A.E., after all, is only one of many instruments used in the good work.

Let me mention a few of the resultful and potential activities recently undertaken by the Engineering Council: The splendid service rendered to the Government, the nation, and the profession, during the war, by the American Engineering Service; the good work now being done by the Engineering Societies' Employment Bureau; the recent organizing of the National Service Committee of the Engineering Council at Washington, with its aim of disinterested usefulness to the nation and the profession; the formation by the Am. Soc. C. E. of its Committee on Development, from which great things are expected in the way of solidifying and otherwise helping the profession; the thorough fashion in which the council is now tackling the question of the licensing of engineers; the recent efforts to induce municipal, state and Federal officials to carry forward public works to help relieve the present industrial situation; the letter to President Wilson urging the appointment of engineers to the Commission on Reconstruction (the President's reply is aptly commented on in a letter by M. S. Parker in *Engineering News-Record* of Feb. 20, 1919, p. 395); the attempts to get justice for the railroad technical engineers, as noted above; and, finally, the action taken with regard to the unjust discharge of nearly 400 engineers of the Public Service Commission, New York.

In connection with this last, I am aware that *Engineering News-Record* in an editorial entitled "Will New York Engineers Fail in Their Civic Duty?" waxed indignant because the council at first refrained from action until the case had been presented to it in a "formal communication." A perfectly correct stand to take, was it not? Certainly, as responsible a body as the council cannot take action merely on the evidence of newspaper headlines and street gossip. Anyway, it eventually acted, and results quickly followed.

It must be recognized that the A. A. E. is doing fine work in its attempts to solve the perplexing "reconstruction" problems of the engineering profession. The task is appallingly large and complex. Does it not seem, however, that the objective of all our efforts should be a merger of the existing engineering and technical societies into one main national organization, with two distinct functional divisions; viz., the scientific or technical, and the economic or service? Affiliated district chapters in all parts of the country could take care of local requirements and be used for social and scientific purposes, as are the numerous independent engineers' clubs under the present disorganized conditions.

Some such bold and comprehensive scheme as this, through which action could be unified, is necessary in order to secure the rights of the profession and to achieve its solidarity and the public recognition to which it is entitled.

E. A. VAN DEUSEN,
Charlotte, N. C. Assoc. M. Am. Soc. C. E.

Increase in Prices Due to Labor

Sir—I have read with much interest the article by O. M. Fox, in your Feb. 20 issue, p. 369, on "Material Prices Halt Chicago Building Operations." From a reading of this article, one would naturally blame the manufacturer for the high cost of material, but the writer has overlooked one vital feature which throws the increase in cost not upon the manufacturer, but upon the labor he employs.

In 1913 boiler makers were paid 42½c. and 45c. an hour, and the cost of a fabricated tank, steel, rivets and labor, overhead and margin, was 5c. a pound. Today, with labor 70c. an hour, the labor cost of building this tank is 10c. a pound, no steel, no overhead, no margin. In other words, if steel cost $20 a ton less than the price now being paid, it would make no material difference in the price for which a manufacturer could sell his tanks; and there will be no material reduction in tank prices until labor is willing to do a day's work for the high price they are paid.

We believe that the case cited above is parallel in almost any line of manufacture, such as engines, generators, pumps, and the manufacture and fabrication of steel structures or any other item where labor enters materially into the cost.

F. F. VATER,
President, Power Plant Specialty Company.
Chicago, Ill.

Safety of Workmen Should Receive First Consideration

Sir—The article published in your issue of Feb. 27, 1919, p. 443, with the title "Awning Reduces Lost Time by Hiding Movements of Derrick," has been read by me with much interest.

Without doubt the principle of avoiding the distraction of workmen's attention from their duties is correct and wise, but in applying it in this particular case a more important principle has been lost sight of completely. The carpenters who "stopped work every time the derrick swung its load and stood ready to dodge if it let go" had some justification for their evident fear. The placing of the awning did not remove this

fear, and I question very much whether the placing of the awning effected any saving in the long run.

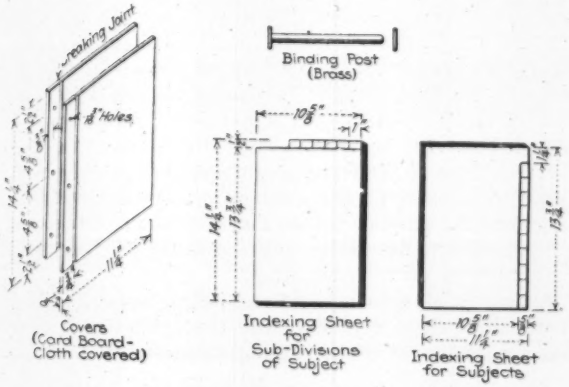
The correct procedure here should have been to avoid even the appearance of danger. The most striking point in the article referred to is that the thought of safety for the workmen does not seem to have entered the mind of the man in charge. This is surprising, considering the attention paid to the matter of safety in these days. J. JAY DUNN.

Ellwood City, Penn.

Engineer's Data File Is Compact and Convenient

Sir—The saying, "He who reads and throws away, may live to rue that very day," once heard is easily remembered, especially when you are looking for that article on a certain subject which you know you had once seen, but cannot recall where or what you did with it. It is the purpose of this article to describe a filing system used by the writer by which it is easy to locate any article deemed of sufficient importance at the time of reading possibly to make it desirable to retain it for later reference.

All articles taken from the various periodicals on subjects of interest, and sometimes the bulletins on various engineering projects, are filed, if not of too bulky a nature, by means of a pair of stiff cardboard covers, brass binding posts and paper separating or indexing sheets, as shown in the sketches. The binding



DETAILS OF CARDBOARD COVERS FOR DATA FILE

posts can be purchased from an office outfitter at about 3c. each for the 4-in. size, which is the longest made commercially. The covers can be made up for about 80c. per pair by a book-binding establishment, where the paper for the separating sheets can also be purchased and later cut as required. The size of the covers shown can be used for filing articles taken from any of the periodicals published today.

The most important part of the filing system, as regards convenience, is the separating or indexing sheets, which are bound together with the articles, according to subjects, in alphabetical order. There are subject headings at both the right-hand side and at the top of the volume. The right-hand notations indicate the subject proper, while the top notations indicate the subdivisions of the subject. For example, suppose the subject of boilers is to be referred to, the subdivisions are construction, operation, land types, testing, marine types, etc., the subdivisions being added as the articles are procured.

Articles should be removed from periodicals by pulling out the wire binders with a pair of pliers, instead of cutting the article out with a knife, which very seldom leaves a sufficient margin for filing by this method.

It can readily be seen that a system of this kind can be made very extensive when taken as a whole, yet very simple, due to the fact that all articles that are pos-

ARTICLE FILE AT ACCUMULATED IN TEN YEARS

sessed on a certain subject are all in one place, in convenient form, instead of all over the library, as they would be if put in permanently bound volumes. The photograph shows to what proportions the writer's article file has attained in 10 years.

Generally, articles are not filed as soon as they are received, due to the amount of labor involved in opening up the volumes, but are laid away until a sufficient number have accumulated to make their insertion advisable, the memory being relied upon in the meantime, or entries being made in a card index. All persons who file various data should maintain a card index in which should be listed all books, papers, etc., in the library. The card index, although not absolutely necessary for this type of article file, is nevertheless a good standby.

For the filing of catalogs, pamphlets, books, etc., the writer uses a system of numbers, combined with the first letters of the alphabet, as follows: All books, etc., are filed in four divisions of size, according to height, each size having a certain letter—i.e., those over 10 in. high are designated by the letter A, over 9 in. high and up to 10 in., by the letter B, 8 in. high and up to 9 in. by the letter C, under 8 in. high by the letter D. Filing is then done by the book or pamphlet taking the next consecutive number according to the division to which it belongs, this number being put on the outside so as to be easily seen. A standard sectional book case is used for filing; it contains also a drawer for the card index. A. H. MYERS,

Chief Inspector, Marine Department, Wellman-Seaver-Morgan Company.

Akron, Ohio.

Overhead Charge Between City Departments

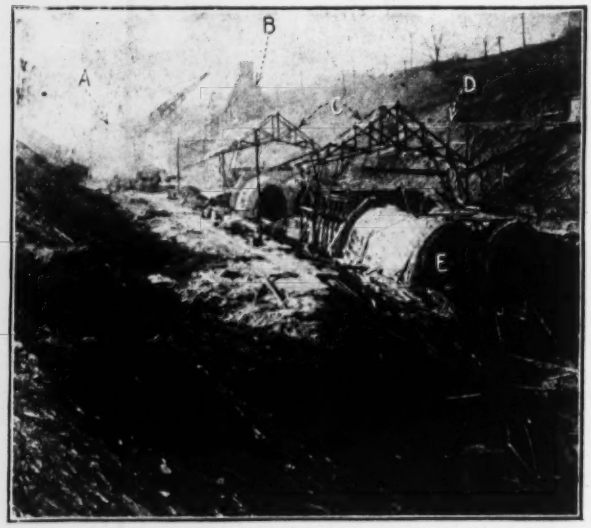
Work done by one department of the City of Detroit for another is paid for at cost plus a percentage for superintendence and overhead expense. The Departments of Public Works and of Parks and Boulevards add 15%, the Public Lighting Commission 10% and the Board of Water Commissioners 20 per cent.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Traveler Carries Concreting Chute and Forms for Conduit

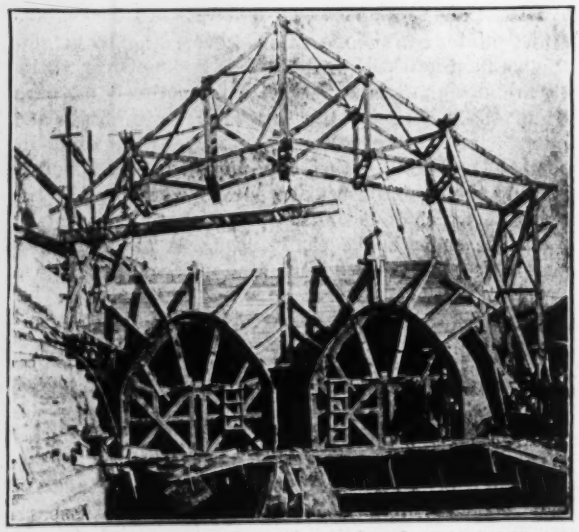
TRAVELERS carry the concreting chutes and handle the outside arch forms, in concreting the outlet conduits for the Germantown dam of the Miami Valley flood-protection works. As the conduit structure at Germantown is at the foot of a very steep hill, it was



TRAVELERS SHIFT CONCRETING CHUTES AND FORMS FROM SECTION COMPLETED TO SECTION BEING BUILT

A. Dragline digging trench for conduits. B. Gravel-washing and concrete-mixing plant. C. Travelers handling forms and chutes. D. Truck for concrete cars.

possible to place a track from the concrete mixer on the hillside well above the level of the highest concrete. From this track the concrete is conveyed to the different



TRAVELERS BUILT BY JOB CARPENTERS FROM DESIGNS OF DISTRICT ENGINEERS

Other Articles in This Issue of Interest to Contractors:

Building a Floating Dry Dock in Well Laid Out Yard — Page 552

Army Trade Skill Tests Applicable in Construction — Page 554

The Construction Division of Our Army: Operation and Maintenance Functions — Page 562

Immediate National Reconstruction Work in France — Page 570

Keep Accurate Costs on War-Time Fee Contract — Page 571

parts of the structure by means of steel chutes suspended from travelers each consisting of two trusses with the necessary supporting columns and braces. These travelers move on a track consisting of a single line of rail placed along each side of the structure.

The method of operation is as follows: When the outside arch forms are to be moved ahead, the chute, which is suspended from the traveler by block and tackle, is drawn up out of the way. The forms, which are made in three sections for easy handling, are then lifted, one section at a time by means of block and tackle, a sufficient height to pass over the collars of the conduit section already constructed, and are suspended from the traveler. The traveler carrying the three sections of the forms and the chute is then moved ahead to the new position, the forms are lowered into place, and the traveler is then moved to the best position for concreting the section and the chute is lowered to the proper angle for concreting.

Arthur E. Morgan is chief engineer, Charles H. Paul is assistant chief engineer, and C. H. Locher is construction manager of the Miami Conservancy District.

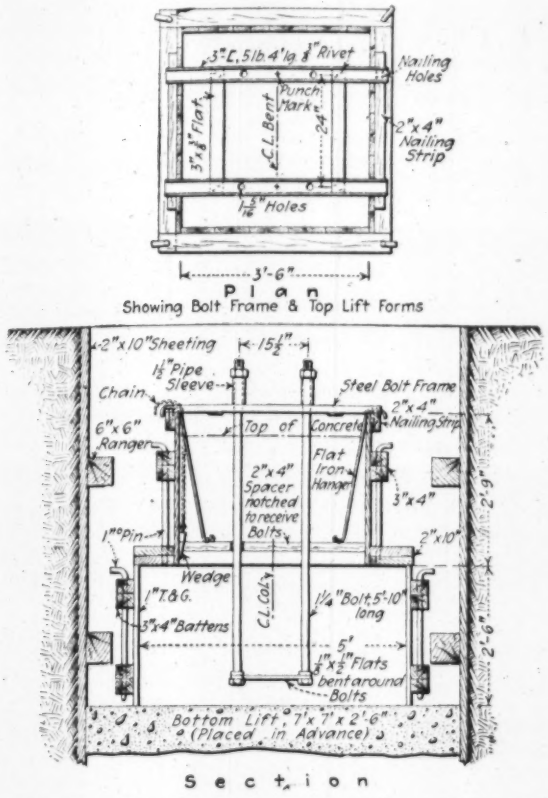
Anchor Bolts Held in Correct Position While Concreting Footings

BY A. P. ROSCOE

Ozone Park, New York

AS THE result of experience in the construction of about a thousand column foundations for an elevated railroad in New York City, there was developed a special bolt frame and templet for facilitating the work of setting anchor bolts to exact line and grade and holding them in position while concrete was placed for the footings.

The form panels for the two upper lifts were assembled on the completed bottom lift, placed a day or two previously. The 1-in. pins used to fasten the forms were found to be difficult to remove after the concreting was done, and were later replaced by tapered pins



DETAILS OF ANCHOR BOLT TEMPLET FOR FOOTINGS OF COLUMNS

of rectangular section fitting into metal-bushed, circular holes in the battens. The completed form was then carefully braced and wedged against the rangers and sheetings so as to prevent lateral movement and to counteract any tendency of the forms to rise because of the pressure of the concrete.

The bolt frame, or templet, constructed of 3-in. channels and 3 x ⅜-in. flats, was accurately drilled for the four 1¼-in. anchor bolts. These frames were light and sturdy and were in good condition when the job was finished. The frame was laid on top of the form and was accurately set by a field party using the center punch marks on the frame; when set they were nailed in place through the nailing holes shown near the ends of the channels. The bolts were set and adjusted to grade by means of the sleeves and nuts shown. This afforded a quick and accurate method of setting the bolts. To hold the anchor bolts in place against the impact of concrete being placed, and to prevent their movement by workmen spading the concrete, they were fastened together at the bottom with ⅜ x ½-in. flats bent around the bolts; at the middle point they were stayed by 2 x 4-in. notched spacers wedged against the inside of the forms. By the time the concrete had reached these spaces the bolts were so firmly held by the concrete (and the bolt frame) that the spacing pieces could be removed and concreting completed to the finished grade. It was found to be worth while to attach a chain to the wedge and iron hangers to the spacing pieces, as shown, so as to permit their ready withdrawal, rather than to waste the time of the entire gang while a laborer fished out the wedges, etc., which operation, owing to the confined space, caused exasperating delays in the beginning.

Hoisting Engines Used to Help Trucks on Seventeen Per Cent. Grade

HAULING of excavated material from the deep cut which is being widened to give railway connection to the South Brooklyn Army supply base was accomplished by means of motor trucks helped by auxiliary hoisting engines. The grade was upward of 17 per cent., and was planked, as shown in the accompanying illustration.

That the trucks might not be delayed, two 9 x 12 hoisting engines were placed at the top of the grade, one on each side. While a truck is coming up on one side, another is going down on the other. Letting the trucks down by cable was not absolutely necessary, but was considered safe and acted as a means for taking the cable down to bring up the next load.

To center the cables on the roadway a deadman consisting of a large steel I-beam, securely embedded in the ground, was placed in the center and just beyond the brow of the hill. To this two large pulleys were attached, and the lines from the engines passed through these and thence down the grade. By this means trucks carrying about four cubic yards of material were easily operated.

This work is under the supervision of the Construction Division of the Army. Brig. Gen. R. C. Marshall, Jr., is chief of the Construction Division, Lieut. Col. H. S. Crocker is constructing quartermaster, and Maj. J. W. Cerny, Quartermaster Corps, National Army, assisted by Capt. L. A. Sumner, is directly in charge of the work described. The general contractor is the Turner Construction Co. of New York City, of which A. C. Tozzer is executive manager, and the subcontractor for the hauling is Rodgers & Haggerty, of New York.

TRUCK BEING HAULED UP STEEP GRADE—NOTE CABLE ATTACHED

NEWS OF THE WEEK

New York, March 20, 1919

Passaic Valley Sewage Disposal Suit Reopened

A reopening of the suit brought by the city of New York against the Passaic Valley Sewerage Commission (nominally the State of New York against the State of New Jersey) has been ordered by the United States Supreme Court. The suit was originally brought in October, 1908, to prevent the alleged pollution of the waters of New York Bay by the treated sewage of Newark and other communities included in the Passaic Valley Sewerage District. Testimony was taken from June, 1911, to June, 1913, but the case was not argued until late in 1918.

The court holds that supplementary evidence is needed. It permits the defendants to take the testimony of not more than three "sanitary or engineering experts" on (1) "any practicable modification of the proposed system of sewage treatment" that would lessen the alleged pollution, and (2) on "any practicable plan of sewage disposal or treatment" applicable to New York City sewage that would lessen the pollution of the harbor. In addition (3) both parties are authorized to take evidence on the degree of pollution of the harbor. The evidence in behalf of the defendants must be in by Aug. 15, 1919. Between then and Sept. 15 the defendants may, if desired, recall in rebuttal the experts who have testified under (1) and (2) and may also offer rebuttal evidence under (3).

After the new evidence is all in, a date for further argument will be set. The evidence will be taken by James D. Maher, clerk of the United States Supreme Court, sitting as a commissioner in New York and Newark. Mr. Maher took the earlier evidence in this case.

Engineering Regiment Cited

For conspicuous gallantry in action on the last night of the war, the Second Engineers were cited in the orders of Maj. Gen. J. A. Lejeune, commanding the Second Division. The citation reads as follows:

1. On the night of Nov. 10, heroic deeds were done by heroic men. In the face of heavy artillery and withering machine-gun fire, the Second Engineers threw two foot-bridges across the Meuse, and the first and second battalions of the Fifth Marines crossed resolutely and unflinchingly to the east bank and carried out their mission.

2. In the last battle of the war, as in all others in which this division has participated, it enforced its will on the enemy.

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Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Professional and Special Section, United States Employment Service:

16 East 42nd St., New York.
63 E. Adams St., Chicago.
1518 Walnut St., Philadelphia.
16 Tremont St., Boston.

N.B. Official information has been received that all offices of the Professional and Special Section of the United States Employment Service will close Mar. 22, unless they can be temporarily continued by local interests. This action is made necessary by the failure of Congress to appropriate funds.

Engineering Societies Employment Bureau; Walter V. Brown, secretary, 29 West 39th St., New York City.

American Association of Engineers, F. H. Myers, manager, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, maintained by the Joint Council of Engineering Societies of San Francisco, care of B. P. Legare, Engineers' Club, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Joint Influenza Committee

The Surgeon Generals of the Army, the Navy and the United States Public Health Service, and the Director of the Census, have created a joint committee to study and compare the influenza data of the various Government departments. The members are: Dr. William H. Davis, chairman, and C. S. Sloane, representing the Bureau of the Census; Dr. Wade H. Frost and Edgar Sydenstricker, of the Public Health Service; Col. D. C. Howard, Col. F. F. Russell and Lieut. Col. A. G. Love, U. S. A.; Lieut. Commander J. R. Phelps and Surgeon Carroll Fox, U. S. Navy.

United States Employment Service Greatly Curtailed

Failure of Congress to pass the Urgent Deficiency Bill in the last days of the session has made it necessary for Secretary Wilson of the Department of Labor to curtail by 80% the United States Employment Service to returning soldiers. It was hoped that this deficiency might be overcome by drawing on President Wilson's war emergency fund, but this has been exhausted.

It is proposed to save a skeleton by retaining a 20% organization, around which various other Government agencies, welfare organizations, etc., will be centralized to carry on the work. In doing this, the 56 regular branch offices which remain of the 750 which had been established will be located in the strategic industrial centers.

Unemployment, as indicated by reports of cities to the Department of Labor, is increasing from week to week, and this curtailment of the Employment Service is considered unfortunate. It is hoped that local communities will continue the Government work.

Training Camps Association Takes Over Employment Work

Left without funds, the Professional and Special Section of the United States Employment Service in Chicago has turned over to the Military Training Camps Association a restricted portion of its work. The association proposes to handle applications from men returning from service only. This means much to engineers, for there are approximately 500 applicants in the Federal files. The Chicago office under the new organization, with W. R. Robinson as its head, has just begun to function, having placed 26 men, exclusive of teachers, during the week which ended Mar. 15. D. A. Tomlinson, who became the head of the office Mar. 15, Mr. Robinson having gone with the Curtis Publishing Co., will remain with the service only until the shift has been effected.

The Military Training Camps Association is located at 220 So. State St., and has a strong national organization maintained by membership fees and contributions. It has the military backing of General Wood, who was recently transferred to Chicago in command of the Central Department of the Army, and has interested himself in the employment situation. For the purpose of continuity of service the association has placed the nucleus of the Federal bureau's staff on its payroll.

Government Surplus Lumber For Sale

The Director of Sales of the War Department has executed a contract with J. L. Phillips and John Stephens, of Jacksonville, Fla., the representatives of the lumber producers, for all of the surplus lumber in the War Department on projects where there is any considerable quantity to be disposed of.

Messrs. Phillips and Stephens can be reached at 708 13th St., N. W., Washington, D. C., and will receive any offers on lumber which they have for sale for the War Department. They have purchased this lumber and agree to resell it at the market price for the various species and grades of lumber, paying to the War Department the amount received for this lumber, less the actual expense of selling; and, in addition, they agree to clean up the entire surplus lumber within the coming six months.

The quantity covered under the contract with the department was 188,000,000 ft., and additional quantities in sight from the department and the Housing Corporation made the amount over 200,000,000 ft. The department has now withdrawn from the contract all the lumber at all the camps and from some storage points, the amount aggregating approximately 160,000,000 ft. This lumber will not be sold. This will leave only between 30,000,000 ft. and 40,000,000 ft. located at widely scattered points and of a variety of sizes, species and grades.

Water-Main Extension Problems Feature of Meeting

Following a short lantern-slide talk on the recent break in a 1200-hp. turbine at the Wachuset dam, by William E. Foss, chief engineer of the Metropolitan Water-Works (as mentioned in *Engineering News-Record* of Feb. 20, 1919, p. 403) the New England Water-Works Association at Boston devoted the rest of its time, after the monthly luncheon on Mar. 12, to a discussion of meeting the cost of water-main extensions. The first speaker, M. N. Baker, of the editorial staff of *Engineering News-Record*, suggested wider use of the assessment-for-benefits plan, especially in view of the fact that the war and prohibition have joined hands in making more difficult than ever the problem of financing municipal improvements.

Coupled with Mr. Baker on the program was C. M. Saville, chief engineer and manager of the Hartford water-works. In Hartford, property owners now guarantee a yearly revenue of 10% for 10 years on the cost of a main large enough to supply the street. C. E. Davis stated that in Philadelphia property is assessed $1 a front foot for main extensions. The assessment is a lien on the property. With a prospect of diminishing revenues due to prohibition, it has been proposed that there be levied an assessment for the high-pressure fire system, based on the cubic space in the buildings projected.

A. R. Hathaway of Springfield, Mass., said that in his city property owners may divide the charge for a water main extension among themselves as they see fit. Leonard Metcalf of Boston approved the general plan of assessment for benefit, which he thought is more common than generally supposed. In the West, where lots are large and much of the city area is sparsely settled, there is a strong argument for the plan. F. P. Stearns thought that the assessment plan would discourage applications for extensions.

Alaskan Railroad Work Curtailed

Owing to the failure of Congress to provide necessary funds, it is probable that work on the Alaskan Government railroads will have to be materially curtailed. The construction work under way even may be reduced, and certainly no new work will be undertaken unless an extra session of Congress should make the needed funds available.

Illinois Has Waterway Project

A new plan for a waterway to form a link in the Lakes and Gulf waterway by connecting the Chicago Drainage Canal with the Illinois River at La Salle, Ill., is contained in a bill submitted to the state legislature. It has the backing of Governor Lowden, and was prepared by the State Department of Public Works and Buildings. The channel will have a bottom width of 150 ft., with a water depth of 8 ft. in earth sections, 10 ft. in rock and 14 ft. over lock sills. Locks 110 x 600 ft. long are provided, enabling fleets with 5000 to 7000 tons of freight to be accommodated. The cost is estimated to come within the bond issue of $20,000,000 which has already been authorized by public vote. When the bill is passed the project will be submitted to the War Department, and it is hoped that approval will be given in time to permit of starting work this season.

Outlook for Highway Improvements in California

Several county bond issues are to be voted on, and several others are proposed, in California, according to reports. A $40,000,000 bond issue is also being contemplated for the state at large.

Among the counties, Fresno will vote on $4,600,000 on May 6, while Sonoma will vote on $1,600,000 on May 27. Marin County has requested a Government engineer to prepare highway plans, and five northern counties have requested an engineer to lay out an intercounty system for them.

In addressing the State Road Supervisors' Association, Governor Stephens stated that the state-wide bond issue mentioned above is about to be proposed, and requested their united support. This was given in the form of a resolution which was passed by a large majority.

Ontario Good Roads Association Meets in Toronto

Great interest in the subject of good roads was shown at the 18th annual convention of the Ontario Good Roads Association, held in Toronto, Mar. 5-7, when 300 delegates met to discuss the road problems of the province. Public work to tide over the labor shortage of the reconstruction period, together with changes in the laws affecting labor upon the roads, was the principal topic of the speakers.

What is known as "statute labor," or working out the road tax, received the greatest amount of discussion at the convention. It was the sense of the meeting, as expressed in a resolution carried by a fair majority, that this form of road administration should be discontinued, and that the road construction of counties should be put under a competent surveyor.

A great increase in motor traffic, as evidenced by the advance in receipts from licenses from $950,000 in 1917 to $1,200,000 in 1918, makes it necessary, according to the Hon. George S. Henry, minister of agriculture, to put the township roads of the present system into such condition that they can be used all the year round.

The following officers were elected for the ensuing year:

President, K. W. McKay, St. Thomas; first vice-president, J. J. Parsons; second vice-president, W. H. Pugsley, Richmond Hill; third vice-president, Capt. Lucius E. Allen, Belleville; secretary-treasurer, the Hon. George S. Henry, member of the provincial Parliament; assistant secretary-treasurer, Maj. T. L. Kennedy.

Federal Highway Council To Hold First Meeting in Chicago

The first meeting of the newly organized Federal Highway Council, described in *Engineering News-Record* of Feb. 6, 1919, p. 303, will be held at the Congress Hotel, Chicago, Apr. 7-8. The meeting will open with an informal "get-together" dinner on Monday evening, Apr. 7.

Representatives of 38 state highway departments, together with 190 prominent men representing civic organizations throughout the entire country, have accepted membership in the council and are expected to be in attendance. Indorsement by many organizations of the national highway policy and plan outlined at the Chicago Highway Congress by E. J. Mehren, editor of *Engineering News-Record*, indicates the interest in highway work throughout the country and suggests a wide field of action for the Federal Highway Council.

Road-Bond Issue Submitted to Vote by Legislature

Another state was added to those which have submitted large highway bond issues to a vote of the people, when the Governor of Washington signed a bill passed by the legislature

providing for a referendum on an issue of $30,000,000. The measure will be voted upon at the general election in 1920 and, if it is carried, the funds will be used to build hard-surfaced roads throughout the state. A bill providing for county superintendents of highways reporting directly to the State Highway Commission, reported in *Engineering News-Record* of Feb. 13, 1919, p. 351, was defeated.

Interior Department Obtains High Explosives for Road Work

High explosives worth $10,000,000 and consisting largely of TNT have been turned over by the War Department to the Department of the Interior for reconstruction purposes. It is reported that Secretary Lane, of the Interior Department, plans to use much of this material for blasting on road-building projects.

Federal-Aid Highway Appropriation Goes Through

Federal aid for highways received a large addition when the Postoffice appropriation bill went through the Senate carrying $200,000,000 for this purpose. The bill, which was noted in *Engineering News-Record* of Jan. 30, 1919, p. 251, now awaits the signature of the President.

The provisions of the bill greatly enlarge the scope of the term "rural post road," to cover roads that either are used or can be used for transportation of the mails. It also increases the maximum payments which the Federal Government can make per mile from the previous amount, $10,000, to $20,000. This will allow the building in coöperation with the states of roads costing $40,000 per mile.

Canada Takes Over Grand Trunk Pacific

The Grand Trunk Pacific Ry. has been taken over by the Canadian government, which assumed control at midnight Mar. 9. The Hon. J. D. Reid, minister of railways, was appointed receiver. This action was caused by an official notification received by Sir Thomas White, acting premier, from the vice president of the railway, that, in view of the fact that the increased rates have not been sufficient to meet the increased operating expenses, it would not be possible for the company, owing to lack of funds, to continue its operations beyond Mar. 10. The War Measures Act was held to provide adequate authority for immediate action by the Government to prevent interruptions in the operation and management of the system.

W. P. Hinton, the general manager, has agreed to conform to the requirements of the Government and to facilitate the carrying out of the powers and duties required by the minister of railways as receiver. The acquisition of the road adds 1964 miles of main road and about 1000 miles of branch line to the Government system.

Oklahoma Society Considers Paving Brick and Concrete Tanks

Influenza compelled the postponement of the annual meeting of the Oklahoma Society of Engineers in October last, and the deferred meeting was held in Oklahoma City, Mar. 6. Trouble with reinforced-concrete tanks was described by R. E. Brownell, district engineer of the Portland Cement Association, and the discussion indicated a general opinion that tanks 12 to 30 ft. high, made with 1:2:4 concrete, should be waterproof if properly built. Mr. Brownell pointed out that to produce strong concrete the water must be measured as carefully as the other materials.

Officers of the society for the short term of 1919 were elected as follows: President, T. P. Clonts, county engineer, Muskogee; vice-presidents, Col. Frank B. King, R. E. Brownell and D. W. Patton; secretary, H. V. Hinckley, Omaha City, Okla.

Civil Service Examinations

For United States Civil Service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of commission, for form 1312.

United States.—Superintendents of road construction, Bureau of Public Roads, Department of Agriculture, Mar. 25: Class A (candidates with four years' responsible charge of construction) $150 to $175 per month: Class B (six years' responsible charge) $185 to $225; Class C (eight years' responsible charge) $230 to $250 a month. File applications before Mar. 25.

United States.—Assistant examiner, Patent Office, Washington, Mar. 26-28, and May 21-23 and July 23-25. Pay, $1500 per year. File applications in time to arrange for examinations at place selected by applicant.

United States.—Chief physicist, qualified in aëronautics, National Advisory Committee for Aëronautics, Langley Field, Hampton, Va., Mar. 25, $3000 per year. Also physicist, $2100 per year. File applications before Mar. 25.

United States.—Senior highway bridge engineers, Apr. 1, Bureau of Public Roads, Department of Agriculture, Washington, D. C. Grade 1 (examination percentage above 70) $2400 to $2700 per year; Grade 2 (percentage above 80) $2800 to $3000 per year; Grade 3 (percentage above 90) $3100 to $3400 per year. File application before Apr. 1.

United States.—Engineer-draftsman, Apr. 22, $1500 to $1800 per year. File application before Apr. 22.

United States.—Transitman, $100 to $125 per month, and surveyor, $125 to $200 per month, Mar. 26-27 and Apr. 23-24. File applications in time to arrange for examination at place selected by applicant.

United States.—Aëronautical engineering draftsman, National Advisory Committee for Aëronautics, Apr. 1, $1500 per year. File applications before Apr. 1.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

The Niagara Peninsula Branch of the Engineering Institute of Canada was formed at a meeting at Niagara Falls, Ont., Mar. 11, attended by members of the Engineering Institute of Canada and other engineers resident in the Niagara district. Frazer S. Keith, general secretary, explained the scope and functions of the Engineering Institute to a large gathering of representatives from St. Catharines, Thorold and Niagara Falls. Visiting engineers were present from New York City, Philadelphia and from the Hamilton branch. The following officers were elected: Chairman, A. C. D. Blanchard, Niagara Falls, Ont.; vice-chairman, W. P. Near, St. Catharines, Ont., and secretary-treasurer, R. P. Johnson, Niagara Falls, Ont.

The Society of Polish Engineers and Business Men in America, with headquarters in the Engineering Societies Building, 29 West 39th St., New York City, has been organized to work in conjunction with the Commercial and Industrial Bureau of the Polish National Department, 33 West 42nd St. The organization is headed by Ralph Modjeski, as honorary president. Steven de Csesznak, publisher of *Export American Industries*, is president.

The Iowa Section of the American Water-Works Association will hold its fourth annual meeting at the State University of Iowa, Iowa City, Apr. 16-17. Preliminary plans for the meeting indicate that a prominent place will be given to the reconstruction and extension problems of water-works under existing abnormal conditions.

The Engineers' Society of St. Paul held its regular monthly meeting Mar. 10. A motion picture, "From Ore to Finish 'National' Pipe," produced by the National Tube Co. of Chicago, was shown. The society was recently represented by a committee which addressed the appropriations committee of the state legislature on the neces-

sity of having an appropriation to continue the topographic mapping of the state, and hydrographic surveys, in conjunction with the United States Geological Survey. The committee representing the society was composed of E. V. Willard, state drainage engineer; G. O. House, general manager of the Northern States Power Co.; L. P. Wolff, consulting engineer, St. Paul, and E. C. Dugan, of the United States Engineer's office, St. Paul.

The **Bankhead National Highway Association** will hold its third annual meeting at Mineral Wells, Tex., Apr. 18-19. Delegates from all the states along the line of the Bankhead Highway, from Virginia to California, are expected to attend. The United States Good Roads Association, of which Senator Bankhead is president, will also meet during the same week at Mineral Wells, beginning on Apr. 14. There will be an exhibit of machinery and materials. J. A. Roundtree, Birmingham, Ala., is secretary of the Bankhead National Highway Association.

The American Association of Engineers will hold a meeting in Chicago, Mar. 21, at which W. E. Skinner will speak on the proposed $10,000,000 soldiers' memorial building.

The Engineers' Club of Philadelphia will be addressed by Joseph A. Steinmetz on "News from the Peace Zone," at the weekly luncheon Mar. 25.

The Technology Club of Syracuse, N. Y., was addressed Mar. 17 by Henry C. Allen, city engineer, on "The Water Supply of Syracuse." On Mar. 24 C. E. Drayer, secretary of the American Association of Engineers, will speak on the work of the association.

The Quincy, Ill., Engineers' Society elected the following officers at the recent annual meeting: President, W. F. Gerdes; vice-president, W. C. Dowd; secretary-treasurer, Dwight P. Child. A paper on street paving, by Webster P. Bushnell, was presented.

The Montreal Branch of the Engineering Institute of Canada will be addressed Mar. 27 by R. de L. French, who will read a paper entitled "Some Notes on the Design and Construction of Reinforced-Concrete Covered Reservoirs."

The **Southern California Association of Members of the American Society of Civil Engineers** has planned a series of discussions on flood control in southern California. The regular meetings of the association have been changed from bimonthly to monthly. After the first topic has been covered, other "local engineering problems of vital consequence to the community" will be considered along professional lines. At the first meeting, which was held on Mar. 12, there was an introduction of the flood-control subject by George G. Anderson, a historical sketch by F. H. Olmsted, and a talk on the physiography involved, by A. L. Sonderegger.

The New England Water-Works Association will hold its next annual meeting in Albany. The time will probably be the second week in September.

The Duluth Engineers' Club held its monthly meeting Mar. 15, at which the committee on local transit reported on Duluth street-railway conditions with respect to factors attending impairment of the service last winter.

The Engineers' Club of Seattle, at a recent meeting, was addressed by Maj. William F. Allison, who spoke on "The Work of the Sanitary Engineers with the American Army in France."

The Engineers' Club of Minneapolis was addressed Mar. 17 by Professor Comstock of the Minnesota State University of Mines, who spoke on "The Mining Industry of Minnesota."

PERSONAL NOTES

COL. F. A. MOLITOR, Twenty-Second Engineers, has been discharged from the Army and has returned to New York to resume his consulting practice. The Twenty-Second Engineers, which Colonel Molitor commanded, was assigned to the construction of light railways. In November Colonel Molitor was detailed from his regiment and placed in charge of engineer supplies.

ROY MULLINS, division highway engineer of New Jersey at Trenton, has been appointed division engineer in charge of the northern division, with headquarters at Newark, succeeding E. M. Vail, who has been put in charge of the new department of maintenance, as noted elsewhere.

MAJ. I. S. OSBORN, Quartermaster Corps, U. S. A., has been discharged from the service and has returned to engineering practice with the Allen-Osborn Co., engineers and architects, of Cleveland, Ohio. At the request of Herbert C. Hoover, he organized the Garbage Utilization Division, United States Food Administration, later resigning to enter the Army to organize the Reclamation Division in the Quartermaster Corps, of which he was chief during the first part of 1918. During the latter part of the year he was assigned to special duties and inspection work in connection with the Salvage Division, Office of the Director of Purchase, Storage and Traffic.

HENRY E. ELROD, DAVID DRENNAN and FRANK S. TAYLOR, formerly of the engineer firm of Lyndon, Taylor & Perrilliat, New York City and New Orleans, have become associated under the firm name of the Henry Exall Elrod Co., Dallas, Tex., consulting engineers, successors to Henry Exall Elrod. The new organization will continue to specialize in municipal work, utility valuation and regulation, and highway engineering.

H. A. SCHAFFER, previously of the firm of Harrison & Schaffer, consulting engineers and chemists, Easton, Penn., has joined the staff of the Portland Cement Association as chemical engineer to conduct conservation studies. From October, 1918, he was acting as advisory chemist and assistant to the Director of Building Materials, War Industries Board, Washington.

MAJ. W. A. WELCH, Air Service Aircraft Production, U. S. A., division engineer, Spruce Production Division, and chief engineer, Spruce Production Corporation, has been discharged from the service and has returned to his former position as chief engineer of the Palisades Interstate Park Commission.

MILO S. KETCHUM, assistant director of the United States Government explosives plant, who since February, 1918, has been in charge of the construction of the smokeless-powder plant at Nitro, W. Va., has returned to the University of Colorado to resume his duties as dean of the College of Engineering and professor of civil engineering.

CAPT. A. U. WETHERBEE, Chemical Warfare Division, U. S. A., who was formerly chief engineer and assistant works manager of the Niagara Alkali Co., recently received his discharge from the service and has become chief mechanical engineer, Powdered Coal Engineering & Equipment Co., Chicago.

LIEUT. C. F. URBUTT, Construction Division, U. S. A., has received his discharge from the service and has been appointed district engineer, Chicago, Milwaukee & St. Paul R.R., with office in Chicago, succeeding W. L. Webb, assigned to special work in connection with the Chicago Union Station, as noted elsewhere.

ARTHUR H. BLANCHARD, consulting highway engineer, New York City, has been appointed chief of the Bureau of Public Works, Department of Citizenship, under the Army Overseas Educational Commission of the Y. M. C. A. General Pershing has requested the Y. M. C. A., through its commission, to take charge of the development of instruction and courses for all educational work of the Army overseas. The staff of the Bureau of

Public Works and Army instructors, in 500 post schools throughout France, will give lectures and courses relative to waterways, railways, highways, bridges, water-supply, sewerage, waste disposal, public utilities, and irrigation.

LIEUT. WILLIAM H. HOBBS, 332nd Field Artillery, American Expeditionary Forces, has received his discharge from the Army and resumed his work as assistant engineer, Louisiana Division, Missouri Pacific R.R., with headquarters at Monroe, La.

H. W. SKIDMORE, construction engineer, Department of Public Works, Village of Oak Park, Ill., on Apr. 1 will become associated with Lester Kirschbraun, consulting and testing engineer of Chicago, and will become associate director of the Chicago Paving Laboratory, devoting practically all of his time to the paving field.

LIEUT. G. D. SHANNON, Ordnance Department, U. S. A., formerly highway division engineer, Vermilion County, Illinois, has received his discharge from the service and has become highway engineer of the Joplin, Mo., road district, in charge of construction.

LIEUT. WILLIAM F. BROCK, Engineers, U. S. A., stationed at Camp A. A. Humphreys, Virginia, has received his discharge from the service and has returned to his work with the Interstate Commerce Commission, Division of Valuation. He is at present located at Newbery, Fla.

L. P. SCOTT, assistant engineer, Road Department, Office of the Constructing Quartermaster, Camp Henry Knox, Kentucky, since his discharge from the service, has become constructing engineer on highway work for Sedgwick County, Kansas, with headquarters at Wichita.

U. S. MARSHALL, senior highway engineer, Bureau of Public Roads, who has just completed the paving work at Camp Lewis, Washington, has been transferred to Missoula, Mont., in charge of Federal road work in the state, succeeding J. S. Bright, transferred to District No. 3, Denver, as noted elsewhere in this issue.

E. M. VAIL, division state highway engineer in charge of the northern division, New Jersey, with headquarters in Newark, has been promoted to head the new department of maintenance.

COL. WILLIAM D. WRIGHTSON, chief of the Sanitary Corps, U. S. A., has received his discharge from the service and has resumed his connection with the International Health Board of the Rockefeller Foundation as sanitary engineer and member of the yellow fever commission. He will sail this month for South America, in company with Maj. Gen. William C. Gorgas, chairman of the commission, and Brig. Gen. Theodore C. Lyster, member of the commission, to investigate yellow fever conditions in Central and South America.

COMFORT AVERY ADAMS, previously professor of electrical engineering and Lawrence professor of engineering, Harvard University and Massachusetts Institute of Technology, has been appointed dean of the School of Engineering at Harvard.

CAPT. ALLAN V. ELSTON, 314th Engineers, American Expeditionary Forces, has received his discharge from the service and has resumed private practice in the firm of Wood, Elston & Witten, consulting engineers, Tulsa, Okla.

JOHN FLYNN, JR., who recently completed his work as project and supervising engineer, United States Housing Corporation project, Watervliet, N. Y., has been appointed village engineer of Green Island, N. Y., for the ensuing year.

LIEUT. FRANK W. VARDEN, U. S. A., formerly with the Koppers Co., has been discharged from the service and has entered the technical department of the Barber Asphalt Paving Company.

O. H. FRICK, field engineer on valuation work, Chicago, Milwaukee & St. Paul R.R., has been appointed district engineer, middle district, with headquarters in Milwaukee.

G. H. BISHOP, previously with the United States Public Health Service, Montgomery, Ala., has become chief engineer for the Cement Products Co., manufacturer of "Sanisept" portable sewage-disposal systems.

J. S. BRIGHT, engineer in charge of the branch office of the Bureau of Public Roads at Missoula, Mont., has been appointed engineer in charge of District No. 3, with headquarters in Denver.

W. F. CRAWFORD and R. N. WHITTESEY have become associated under the firm name of Crawford & Whittesey, civil and consulting engineers, Sapulpa, Okla.

MAJ. JAY A. ROSSITER, formerly track elevation engineer, Chicago, and CAPT. C. C. SANER, assistant engineer, on the city engineer's staff, Chicago, announce the opening of a sales engineer's office in the Union National Bank Building, Houston, Tex. Major Rossiter and Captain Saner were connected with the 108th Engineers, formerly a Chicago National Guard regiment. The new firm, Rossiter & Saner, represent the following manufacturers: Page-Burton Boiler Co.; F. C. Austin; Yeomans Bros.; Williams-Wendt Co.; Austin Manufacturing Co.; Baylis Sanitary Supply Co.; Chicago Waste Co.; American Steam Conveyor Corporation; Boland Construction Co.; Municipal Supply Co.; Universal Engineering Co., and Typhoon Ventilating System.

W. L. WEBB, district engineer, Chicago, Milwaukee & St. Paul R.R., with headquarters in Chicago, has been assigned to special work in connection with the Chicago Union Station.

JOSEPH W. HUNTER, formerly state highway commissioner and since 1911 first deputy highway commissioner of the Pennsylvania State Highway Department, has been appointed township commissioner of the department.

LIEUT. ALLEN F. SHERZER, 301st Feld Artillery, American Expeditionary Forces, has resumed his work with the Kingsford Foundry & Machine Works, Oswego, N. Y., having received his discharge from the service.

ROBERT C. BERLIN,, PERRY W. SWERN, and FRANK A. RANDALL have become associated as the firm of Berlin, Swern & Randall, architects and engineers, 19 So. La Salle St., Chicago.

GEORGE H. BILES, second deputy highway commissioner of Pennsylvania for the past three years has been appointed assistant highway commissioner.

R. A. BOOTH has resigned as state highway commissioner of Oregon.

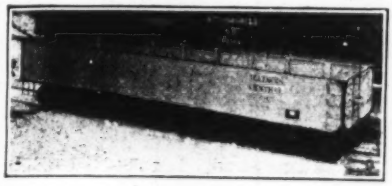
OBITUARY

LYNDEN B. SCHOEMAKER, for the past nine years engineer of distribution, Department of Water Supply, Brooklyn, N. Y., died in that city Mar. 10, at the age of 34. He was graduated from Princeton in 1906 and served as an instructor during the following year, afterward entering the service of New York City.

THOMAS FLETCHER OAKES, former president of the Northern Pacific R.R., died in Seattle Mar. 14 at the age of 76. He directed the construction of the road from Spokane to Seattle. In 1863 he entered the service of the Kansas Pacific Ry., from which he resigned as vice-president in 1879 to become general superintendent of the Kansas City, Fort Scott & Gulf R.R. He later served as vice-president and general manager of the Oregon Ry. & Navigation Co. In 1881 he became vice-president of the Northern Pacific, and served as president from 1888 to 1893, when he was appointed receiver for two years.

Concrete Freight Car Designed to Relieve Steel Shortage

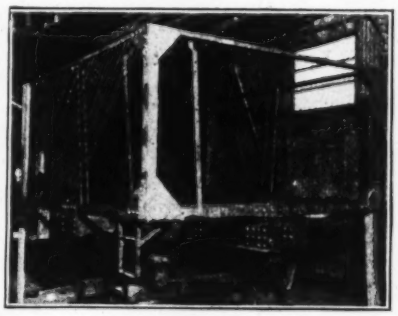
A reinforced-concrete gondola car, having concrete sides, ends and floor with a steel skeleton body frame, and mounted on a steel underframe, was on exhibition in Chicago recently and represents a new development in the use of concrete. It was designed during the war as a means of relieving the shortage of steel and the demand for cars, but plans are being made for



FREIGHT CAR HAS CONCRETE SIDES AND FLOOR ON STEEL FRAME

manufacturing various types of concrete cars on a commercial scale.

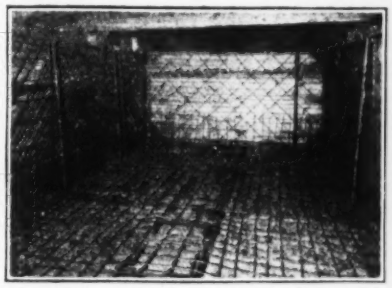
The car has a body 41 ft. long, 9 ft. 8 in. wide and 4 ft. 8 in. deep. It is designed for 50 tons load capacity plus 10% for overload. Unit stress was taken at 16,000 lb. in steel and 1000 lb.



STEEL FRAME AND REINFORCEMENT OF CONCRETE FREIGHT CAR

in concrete. Impact was computed at 25%. As the thickness of the concrete is only 2½ in., it was decided to use the cement gun for making the sides and floor, the cross-bearers being poured in the usual way. Forms were placed on the outside of the frame, and the concrete was shot from the interior. The density of the concrete applied in this way increased the weight, but it is estimated that cars of this size and design can be made weighing 23 to 24 tons. A new light-weight aggregate, known as haydite and invented by Stephen J. Hayde, of Kansas City, was used. This makes concrete said to weigh 104 lb. per cubic foot, with a compressive strength of 4450 lb. in 28-day tests.

The car was designed by J. B. Strauss and built by the R. F. Conway Co., while many parts of the equipment were contributed by the Illinois Central R.R. After 30 days' service on that road it will be turned over to the United States Railroad Administration. The



REINFORCEMENT FOR CONCRETE FLOOR, SIDES AND ENDS OF CAR

Concrete Car Co. has been organized by J. J. McCarthy, Joseph B. Strauss and F. E. Sullivan, of Chicago.

BUSINESS NOTES

The Sullivan Machinery Co., Chicago, announces the establishment of a branch office at Edificio Oliver No. 3, Mexico City, in charge of Joseph F. Bennett. The appointment of Chester Mott as manager of the Denver, Colo., office, succeeding Wallace T. Roberts, resigned, is also announced.

Twenty-one years' of service have brought G. W. Burrell to the assistant vice-presidency of the Wellman-Seaver-Morgan Co. He will have entire charge of the company's work, both at Cleveland and Akron.

The Chicago Pneumatic Tool Co. announces the removal of its Cleveland district office from Room 813 to Rooms 406-408 Engineers Building, effective Mar. 1. The new headquarters will serve the company's interests within the Cleveland district. Ross Watson is district manager.

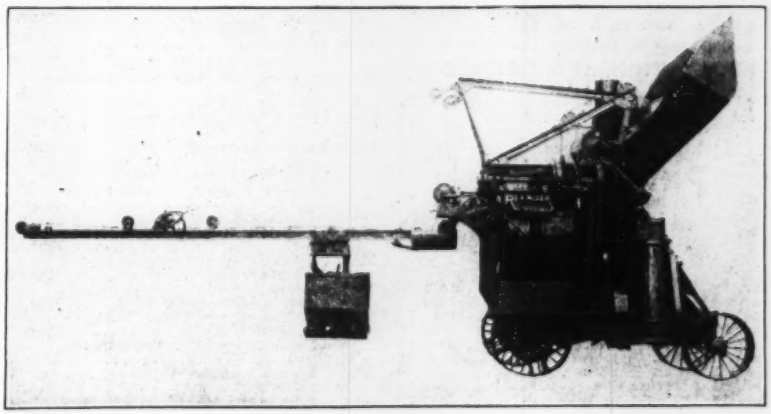
Turning from war to peace interests, the Associated Metal Lath Manufacturers have moved from Washington to their pre-war offices in the Swetland Bldg., Cleveland. During the war, Wharton Clay, who is the new commissioner, was connected with the Military Training Camps Association, in the work of placing men of special qualifications. The assistant commissioner is C. O. Powell, formerly with the Northwestern Expanded Metal Company.

Andrew Barr, who has been associated with the United States Wind Engine and Pump Co. since 1914, has accepted a position as superintendent of the foundry of the Waterloo Gasoline Engine Co., Waterloo, Iowa.

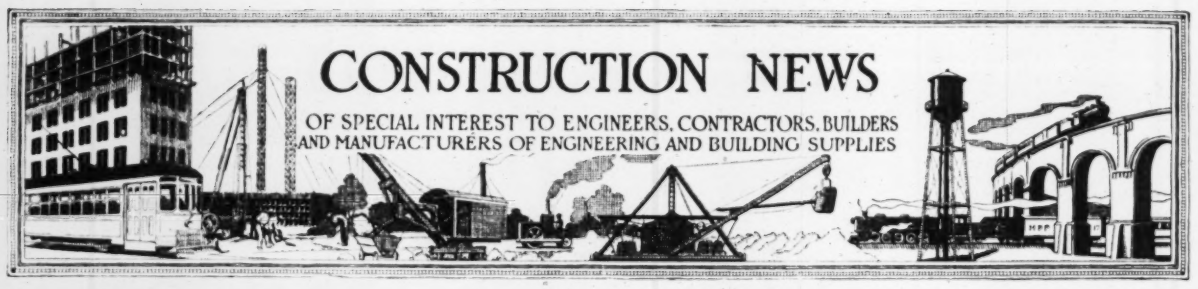
The Appraisal Engineering Co., Seattle, has opened offices at 409 Burke Bldg., as engineers and building contractors. Joseph Klein is superintendent.

New Paving Mixer Has Inclosed Transmission

A step toward automobile practice is marked in the concrete paving mixer field by the announcement of the 1919 model "Rex" 14-E, manufactured by the Chain Belt Co., of Milwaukee, shown in the cut. The sprocket chain drive is retained in the new model, which has rated forward speeds of 84 and 120 ft. per minute and a reverse speed of 90 ft. per minute. As suggested by its number, the machine has a wet concrete capacity of 14 cu.ft. It has a 90-in. loader, allowing the use of two wheelbarrows, and is equipped with either a 20-ft distributing boom or a 15-ft. spout, which receives the concrete at a height of 60 in. above the ground. The power plant is underslung, in order to lower the center of gravity. The overall width of the machine is 8½ ft., and the total height is 13 feet.



MIXER HAS INCLOSED TRANSMISSION GEARS SIMILAR TO AUTOMOBILE'S


CONSTRUCTION NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

PROPOSALS

For Proposals Advertised See Pages 63-69 inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Mar. 24	Minot, N. D.	Mar. 6
Mar. 25	Jersey City, N. J. Adv. Feb. 27 and Mar. 13.	Feb. 20
Apr. 15	Duluth, Minn.	Mar. 13
Apr. 16	Kansas City, Mo.	Mar. 20

SEWERS

Mar. 24	Detroit, Mich.	Mar. 13
Mar. 24	New York, N. Y.	Mar. 20
Mar. 25	Youngstown, O.	Mar. 20
Mar. 26	Brooklyn, N. Y.	Mar. 20
Mar. 28	Chicago, Ill.	Mar. 20
Mar. 30	Hagerstown, Md. Adv. Mar. 20.	Mar. 20
Mar. 31	Central Falls (Pawtucket P. O.), R. I.	Mar. 20
Apr. 1	Great Falls, Mont.	Mar. 20
Apr. 1	Harrison, N. J.	Mar. 6
Apr. 1	Newark, N. J.	Mar. 6
Apr. 2	Hamilton, Ont.	Mar. 13

BRIDGES

Mar. 22	Taylorville, Ill.	Mar. 20
Mar. 23	Buckhannon, W. Va.	Feb. 13
Mar. 24	Middlebourne, W. Va.	Mar. 6
Mar. 24	Roundup, Mont.	Mar. 20
Mar. 25	Jersey City, N. J.	Mar. 13
Mar. 27	Janeville, Wis. Adv. Mar. 6 to Mar. 20.	Mar. 6
Mar. 28	St. Remi, Que.	Mar. 20
Apr. 1	Peterborough, Ont.	Mar. 13
Apr. 1	Ft. Dodge, Ia.	Mar. 20
Apr. 7	Adna, Wash.	Mar. 20
Apr. 7	Rawlins, Va.	Mar. 20
Apr. 7	Stella, Va.	Mar. 20
Apr. 8	Lewisburg, W. Va. Adv. Mar. 13 and 20.	Mar. 20
Apr. 10	Clarksville, Pa.	Mar. 20
Apr. 11	Holyoke, Mass. Adv. Mar. 13 and 20.	Mar. 13
Apr. 15	Copper Valley, Va.	Mar. 20
Apr. 16	Ottawa, Ont.	Feb. 20
Apr. 22	Kingston, N. Y. Adv. Mar. 20.	Mar. 20

EXCAVATION AND DREDGING

Mar. 26	Marion, Kan. Adv. Mar. 13 and 20.	Mar. 13
Mar. 27	North Bergen, N. J.	Mar. 20
Mar. 31	Cleveland, O.	Mar. 20
Apr. 4	Whiteside, Ill. Adv. Mar. 6 to 20.	Mar. 6
Apr. 8	Hollandale, Miss.	Feb. 13
Apr. 10	Newport, Ark.	Mar. 13

INDUSTRIAL WORKS

Mar. 24	Newark, N. J.	Mar. 13
Mar. 25	Charleston, S. C.	Mar. 6
Mar. 28	New York, N. Y.	Mar. 13
Mar. 31	Orillia, Ont.	Mar. 6
Apr. 1	Quebec, Que.	Mar. 13
Apr. 1	Sioux City, Ia.	Jan. 16
Apr. 1	Boonville, Mo.	Mar. 20
Apr. 1	Astoria, Ore.	Mar. 20
Apr. 18	Sheboygan, Wis.	Mar. 20

BUILDINGS

Mar. 23	Dayton, O.	Mar. 13
Mar. 24	Hawley, Minn.	Mar. 20
Mar. 25	Bath, N. Y.	Feb. 27
Mar. 28	West Unity, O.	Feb. 27
Mar. 31	Ottawa, Ont.	Mar. 6
Mar. 31	Edgard, La.	Mar. 13
Mar. 31	Charlotte, N. C.	Mar. 20
Mar. 31	Chicago, Ill.	Mar. 20
Apr. 2	Fairfield, Cal.	Mar. 20
Apr. 2	Lansing, Mich.	Mar. 6
Apr. 2	New York, N. Y.	Jan. 23
Apr. 2	Duluth, Minn.	Mar. 20
Apr. 2	Lansing, Mich.	Mar. 20
Apr. 4	Seattle, Wash.	Mar. 13
Apr. 7	Ordway, Colo.	Mar. 20
Apr. 10	Newaygo, Mich.	Feb. 6
Apr. 15	Newark, N. J.	Feb. 6
Apr. 22	Bovey, Minn.	Mar. 20
May 1	Wakefield, Minn.	Mar. 20

FEDERAL GOVERNMENT WORK

Mar. 24	Dredging — Wilmington, Del. Adv. Feb. 27 to Mar. 20.	Feb. 27
Mar. 24	Valve Operating Machinery —Wheeling, W. Va. Adv. Feb. 27 to Mar. 20.	Mar. 6
Mar. 24	Boatshead—Spec. 3472—Pensacola, Fla.	Mar. 6
Mar. 24	Fuel Oil Storage Plant—Spec. 3631—Mare Island (Valleyjo P. O.), Cal.	Mar. 13
Mar. 24	Cranes—Spec. 3822—Boston, Mass.	Mar. 13
Mar. 24	Forced and Induced Draft Fans—Spec. 3793—Norfolk, Va.	Mar. 13
Mar. 24	Incinerator—Spec. 3790—Indian Head, Md.	Mar. 13
Mar. 24	Extension to Fresh Water System—Spec. 3805—Pensacola, Fla.	Mar. 13
Mar. 24	Forced and Induced Draft Fans—Spec. 3793—Philadelphia, Pa.	Mar. 13
Mar. 24	Water Tanks—Spec. 3826—Newport, R. I.	Mar. 20
Mar. 24	Swimming Pools—Washington, D. C. Adv. Mar. 20.	Mar. 20
Mar. 25	Remodeling Post Office, etc. —Providence, R. I.	Feb. 27
Mar. 26	Drainage—St. Louis, Mo. Adv. Feb. 27 to Mar. 20.	Mar. 6
Mar. 26	Post Office — Youngstown, O.	Mar. 13
Mar. 26	Alterations — Meridian, Miss.	Mar. 20
Mar. 26	Grading — Washington, D. C. Adv. Mar. 13.	Mar. 13
Mar. 27	Barracks — West Point, N. Y. Adv. Mar. 6 to Mar. 20.	Mar. 6
Mar. 27	Post Office and Custom House, Albany, N. Y.	Mar. 13
Mar. 29	Lock and Abutment-Greenup, Ky. Adv. Feb. 27 to Mar. 20.	Mar. 6
Mar. 31	Coal—Memphis, Tenn. Adv. Mar. 6 and Mar. 20.	Feb. 27
Mar. 31	Dredging—Wilmington, Del. Adv. Mar. 6 to Mar. 20.	Mar. 6
Mar. 31	Power Plant Improvements —Spec. 3389 — Pensacola, Fla. Adv. Mar. 13.	Mar. 13
Mar. 31	Boathouse—Spec. 3786—Newport, R. I.	Mar. 20
Mar. 31	Dredging—Spec. 3597—Ft. Lafayette, N. Y.	Mar. 20
Mar. 31	Quay Wall, etc. — Spec. 3726—Newport, R. I.	Mar. 20
Mar. 31	Cranes — Spec. 3794 — Alexandria, Va.	Mar. 20
Apr. 1	Cement—Conneaut Harbor, O.	Mar. 13
Apr. 2	Post Office—Honey Grove, Tex.	Mar. 6
Apr. 2	Sewer and Water Supply —Stapleton, N. Y.	Mar. 13
Apr. 4	Post Office—Eldorado, Kan.	Mar. 6
Apr. 4	Bear Trap Leaves—Cincinnati, O. Adv. Mar. 6 to Mar. 20.	Mar. 6
Apr. 5	Pass, Weir, etc. — Wheeling, W. Va. Adv. Mar. 13 and 20	Mar. 20
Apr. 7	Timber Wharf — Spec. 3801 —Chelsea, Mass.	Mar. 20
Apr. 7	Roads — Spec. 3796 — Chelsea, Mass.	Mar. 20
Apr. 15	Pumps, etc.—Omaha, Neb. Adv. Feb. 27 and Mar. 6	Mar. 6
Apr. 18	Post Office—Mt. Pleasant, Mich.	Mar. 13
Apr. 21	Post Office — Rhinelander, Wis.	Mar. 13
Apr. 23	Post Office—Gilmer, Tex.	Mar. 13

MISCELLANEOUS

Mar. 23	Structural Steel — New York, N. Y.	Mar. 20
Mar. 24	Gasoline and Kerosene — New York, N. Y.	Mar. 20
Mar. 25	Foundation — Philadelphia, Pa.	Mar. 13
Mar. 25	Air Compressor — Marion, Ind. Adv. Mar. 13 and 20.	Mar. 13
Mar. 25	Paving Material—Detroit, Mich.	Mar. 20
Mar. 25	Ballast—New York, N. Y.	Mar. 20
Mar. 26	Truck and Miscellaneous Supplies — Schenectady, N. Y.	Mar. 20
Mar. 27	Pier—Philadelphia, Pa. Adv. Mar. 13 and 20.	Mar. 13
Mar. 27	Rebuilding Crib Bulkhead —New York, N. Y.	Mar. 20
Mar. 31	Boardwalk—Seaside, N. J.	Mar. 13
Apr. 8	Road Materials—Columbus, O. Adv. Mar. 13 and 20.	Mar. 20

STREETS AND ROADS

Mar. 21	Rhode Island Adv. Mar. 13.	Mar. 13
Mar. 24	Rugby, N. D.	Mar. 6
Mar. 24	Stony Creek, Pa.	Mar. 20
Mar. 24	Grafton, N. D.	Mar. 20
Mar. 24	Beaumont, Tex.	Mar. 6
Mar. 24	New Haven, Conn.	Mar. 20
Mar. 24	New York, N. Y.	Mar. 20
Mar. 25	Buffalo, N. Y.	Mar. 20
Mar. 25	North Bergen, N. J.	Mar. 20
Mar. 25	Kearney, N. J.	Mar. 20
Mar. 25	New Essington, Pa.	Mar. 20
Mar. 25	Massachusetts	Mar. 20
Mar. 25	Salt Lake City, Utah	Mar. 20
Mar. 25	Bottineau, N. D.	Mar. 6
Mar. 25	Mt. Olive, N. C. Adv. Mar. 6 and 13.	Mar. 13
Mar. 25	Pillsburg, Pa.	Mar. 13
Mar. 25	Youngstown, O.	Mar. 20
Mar. 25	Wheaton, Minn.	Mar. 20
Mar. 26	Baltimore, Md.	Mar. 20
Mar. 26	Fairmont, W. Va. Adv. Mar. 6 to Mar. 20.	Mar. 6
Mar. 26	Delaware, N. J.	Mar. 6
Mar. 27	Danville, Ill.	Mar. 20
Mar. 27	Michigan	Mar. 13
Mar. 27	Devils Lake, N. D.	Mar. 6
Mar. 27	Center City, Minn.	Mar. 6
Mar. 27	New York, N. Y.	Mar. 13
Mar. 28	Wheaton, Ill.	Mar. 20
Mar. 28	Buffalo, N. Y.	Mar. 20
Mar. 28	New York, N. Y.	Mar. 20
Mar. 28	Toledo, O.	Mar. 20
Mar. 28	Ohio	Mar. 20
Mar. 28	Anoka, Minn.	Mar. 13
Mar. 28	Dayton, O.	Mar. 6
Mar. 28	Pennsylvania Adv. Mar. 6 to Mar. 20.	Mar. 6
Mar. 31	Lockport, N. Y.	Feb. 6
Mar. 31	Ottawa, Ont.	Feb. 27
Mar. 31	Central Falls (Pawtucket P. O.), R. I.	Mar. 20
Mar. 31	Youngstown, O.	Mar. 20
Apr. 1	Raleigh, N. C.	Mar. 20
Apr. 1	Salt Lake City, Utah	Mar. 20
Apr. 1	Billings, Mont.	Mar. 20
Apr. 1	Kansas City, Mo.	Mar. 20
Apr. 2	Gold Beach, Ore.	Mar. 13
Apr. 2	Michigan	Mar. 13
Apr. 2	Santa Ana, Cal.	Mar. 13
Apr. 2	Boston, Mass.	Mar. 20
Apr. 2	Durham, N. C.	Mar. 20
Apr. 2	Bamberg, S. C.	Mar. 20

Engineering News-Record

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March 27, 1919

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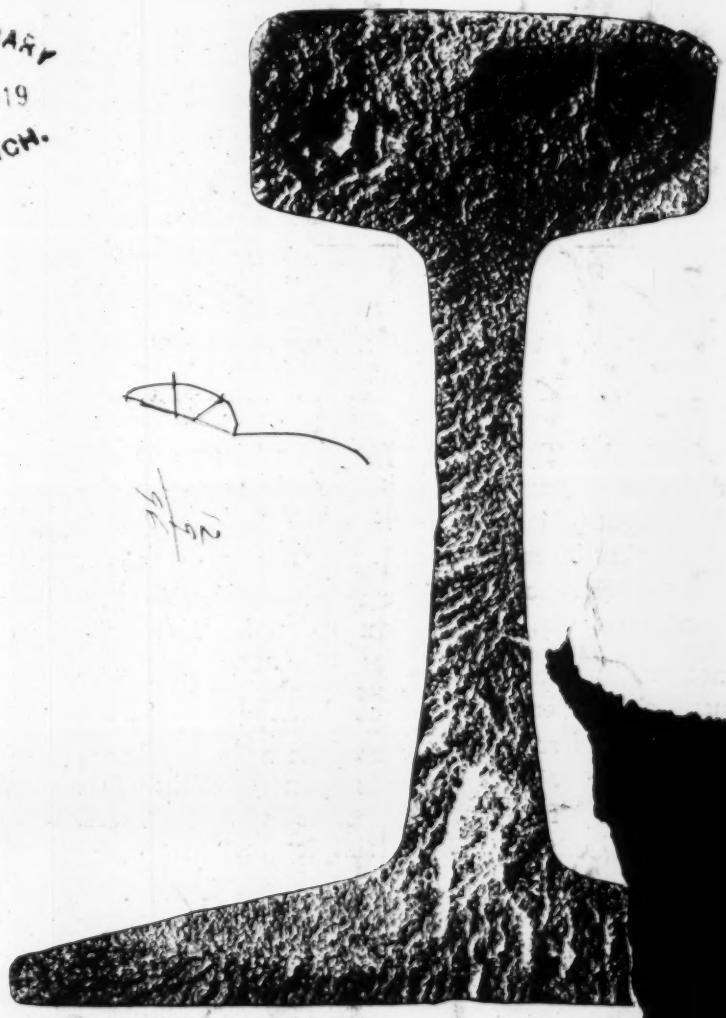
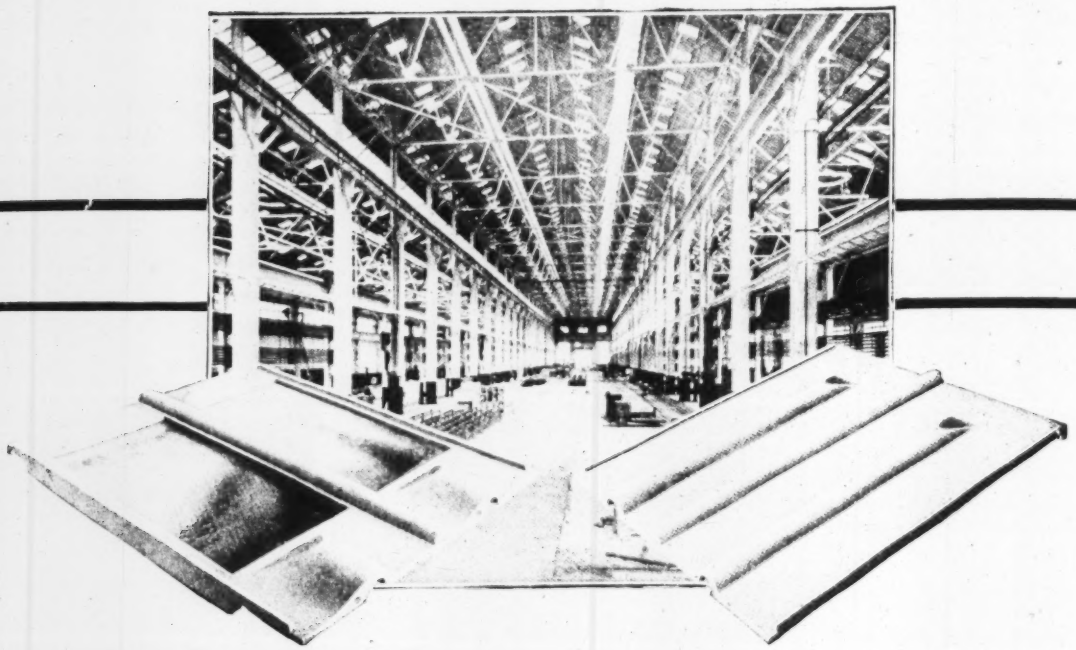


Transverse fissure in 90-lb. rail that broke after five

RAIL FAILURES

For nearly ten years the transve
the greatest problem of railway t
progress in solving it was made
out for the American Railway Engineering As
issue, throw new light on the causes of transvers

REPORT OF ANNUAL
OF AMERICAN RAILWAY ENGINE



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The Federal Roof has an over-all economy which in itself is an advantage of merit. It is *laid directly on the purlins* and therefore requires the simplest steel under structure. Federal Glass Tile are interchangeable with Federal Pitched Tile and should it be desirable to shift them about the roof to provide more intense lighting for particular work it is a simplest matter.

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

Volume 82 — NEW YORK, THURSDAY, MARCH 27, 1919 — Number 13

Time Economy in the Use of Society Lists

THE latest issue of the *Proceedings* of the American Society of Civil Engineers carries the information that the Publication Committee recommended to the Board of Direction, as a measure of economy, the omission of the alphabetical and deceased-members lists from the forthcoming "List of Members." If the society wants (1) to save money, (2) to economize in the time of its members, (3) to cease the absurdity of publishing a directory of the directory, it will eliminate the present alphabetical direct-you-to-the-proper-page-to-find-the-address list and consolidate the names of all members, no matter what the grade, into a single list. The national mechanical and electrical societies have long since done it. It is a time-saver. One search gives all of the information, instead of the two searches required now.

Criticism of Bureau of Public Roads Unfounded

RECENTLY criticism has been heard that the Bureau of Public Roads has been delaying the states in their Federal-aid work, the delay being attributed to the failure to appoint a new director. To ascertain the facts, *Engineering News-Record* sent telegrams to 10 state highway engineers, well distributed geographically. The answers are unanimous that there has been no delay. In fact, some of them indicate that there has been improvement. However, some of the officials feel that injury to the organization and work will result if the appointment of a director is unduly delayed. In this feeling all will concur. The sooner the new director takes office, the better it will be for the road-building interests of the country. Disorganization is bound to follow if the present uncertainty is allowed to persist much longer.

A Fair Day's Pay for a Fair Day's Work

IN THIS issue will be found a brief article, by J. B. Lippincott, which goes to the heart of one of the critical situations of the day—that of wages. Mr. Lippincott shows that on a certain operation excellent results were accomplished in an endeavor to persuade the men that, in order to maintain the war wage-scale, they had to give an adequate day's work. The closing down of the operation prevented carrying the work to a very much higher stage of efficiency, but the incident is sufficient to indicate both to employee and manager that the way out of present wage controversies is for the one to guarantee a fair day's work and the other to guarantee a fair day's pay. The disposition among employers, so far as we have been able to ascertain, is to maintain the present rate of wages, asking in return either pre-war efficiency or an efficiency readily attainable by the average worker. If the worker will see the need of fair production and will be guaranteed a good wage for it, many of our industrial difficulties will be quickly cured.

First Big, Worth-While Step In Compensation Efforts

LAST week's conference on salaries of engineers in railroad service, held under the auspices of the American Association of Engineers, marks the first big, worth-while step in the long discussion on compensation. Various societies have standardized the fees of consulting engineers, and here and there have even suggested the proper rates for employed engineers. For the first time, though, a nationally representative meeting of engineers has proposed a schedule of salaries for a large section of the profession. Furthermore, they propose to get action, to press home to the Railroad Administration the fairness of the approved schedule. The action at Chicago is certain to have a stimulating effect on the whole compensation discussion. It will give it definiteness. There is now a norm to which discussion can be referred. The men who did the work of the conference and the society, the American Association of Engineers, which arranged it, deserve great credit for their accomplishment. Every engineer will be with them in their future steps with the adopted schedule.

Resort to Primitive Tools Often Wise Plant Selection

SELECTION of a hand derrick instead of a more modern hoisting machine to place the considerable volume of stone required to repair the masonry dam described in *Engineering News-Record* of Mar. 13, 1919, p. 517, demonstrates a more alert perception of the art of plant selection than is apparent in many construction operations. With the multiplicity of highly perfected power tools, the constructor falls very easily into the habit of regarding the choice of a less modern tool as a violation of good practice. Instead, as was the case in the dam work at Willimantic, the truly scientific procedure often is to revert to a primitive tool. The installation of a power derrick on this work, however efficient it may be by itself, would have been an error in plant selection. The speed and output of the power derrick could not have been utilized, while the cost of getting the heavier plant onto the work and of keeping it supplied with fuel might easily have increased the cost per unit of output to a figure which would show no economy, compared with the use of a hand derrick. It is as easy to over-plant a construction operation as it is to fail to provide sufficient equipment. The resultant lack of economy is often quite as great.

A Forward-Looking Railway Convention

IN ITS record-breaking meeting at Chicago last week the railway engineering profession made full response to the call of the times. Coming after the stress and confusion of war railroading, the inspiring energy and hopefulness evident at the meeting gave unmistakable promise of a broadening and deepening of technical work in the railway field. Yet even during the war research was active in the solution of transportation problems. The notable studies of rail quality recorded on another page open the first definite prospect of distinct advance in this subject that has appeared in years. Remarkable work, too, was done in the study of bridge specifications, a foundation stone of structural safety. The greatest achievement of the past year, however, was the liberalization of thought among railway engineers of which the meeting gave repeated evidence. With new views on the engineer's relation to labor, and a coöperative spirit forming with regard to the manufacturers who aid in developing railway materials and methods, a basis is given for progress greater than that of any prior period.

Conference on Federal Public Works Department

A NATIONAL convention of engineers representing every branch of the profession, made up of delegates chosen by all classes of engineering societies, local and state societies as well as national, has been called by the Engineering Council to assemble at Chicago Apr. 23-25 to discuss the proposed Federal department of public works. Never before has it been attempted to bring the influence of the entire engineering profession to bear on a great project for public welfare. In fact, no such convention representing all branches of the engineering profession has ever been laid. The nearest approach to it was a convention held in Cleveland 33 years ago, or Mar. 31, 1886, when delegates from 23 local societies of civil engineers met to organize to further the project, then as now a matter of deep interest to engineers, for a national department of public works. It is not strange that the movement of that day failed of success. The total membership of all the 23 engineering societies which joined in that Cleveland convention 33 years ago was less than the number of members in any one of many of the representative local engineering societies of today, to say nothing of the huge roll of members in the national societies. More than 50,000 engineers will probably be represented at the Chicago convention. If the united influence of this great body of engineers can be put behind a well worked out plan for a Federal department of public works, at this time when the public is demanding greater efficiency in Governmental business, there is good hope for success.

Simple Tests Disclose Trade Skill

MANAGERS of the "practical" school as a rule believe that the engineer's methods of analysis fail when the problem of appraising applicants for work is up for solution. The work of a few pioneers in recent years has gone far to discredit this belief. Unfortunately, this work is not generally known. Even engineers do not know it well. And, because in all problems of human relations there is a residuum which does not break down under analysis, even some engineers have dismissed the problem as unsolvable by engineering methods. It is these conditions which lend special interest as well as value to the experience of the personnel organization of our new Army in appraising the trade skill of thousands of recruits. The general method of conducting trade-skill tests for Army workers were outlined on page 554 of last week's issue. The simplicity of the operation is exceeded only by the conclusiveness of the results obtained. The Army experience has demonstrated other facts of equal importance to construction and to industry generally. Trade-skill tests are expensive neither in time consumed nor in equipment required, nor in the cost of skilled direction. They operate as well in selecting men for the industries as in selecting men for warfare. They involve no previously unknown methods. War experience here, as in a score of other directions, has rendered a service to business.

Discussion for the Guidance of the Development Committee

SEVERAL members of the Development Committee of the American Society of Civil Engineers have recently expressed their disappointment at not having received from the members suggestions regarding the conduct and desirable activities of the society. Some local sections have given expression to views on certain topics, but on the whole the membership has remained inarticulate. Naturally, the Development Committee needs to have the best thought of the whole membership. Individual opinion, however, is not likely to be freely offered until the committee takes the initiative by presenting something concrete for discussion. It need not be the conclusion of the majority. In fact, alternative plans will be as effective in stimulating discussion as would a single plan more or less matured.

But while individual expression of views may not be readily forthcoming, there is another means—through studies and reports of local association of members—of learning what a large part of the membership desires. The Philadelphia and Pittsburgh groups have already pointed the way. Both have organized section development committees, which, in turn, have been divided into subcommittees paralleling those of the Development Committee itself. These local development committees have already sent to their respective associations reports that have had intelligent and eager discussion. At Philadelphia the report has been circulated confidentially to the members, in order that they may give it close study and be prepared to discuss it with greater thoroughness at the April meeting.

In both cases the local associations' representatives have attended the meetings and have looked upon the work as a process of formulating the opinion of the local members for their (the representatives') guidance.

What Philadelphia and Pittsburgh have done the other local associations should proceed to do. Then, as the conclusions of each section are formulated, they should be published. They will thus not only stimulate the thinking of the other sections, but also of individuals without local-section affiliations. The resulting discussion should furnish information and suggestions that will help the parent Development Committee in the discharge of its weighty but inspiring duty.

Road Contractors Must Prepare for Dry Concrete

CONTRACTORS for concrete roadwork must be prepared to alter their construction methods. The star of dry concrete is ascendant. Convinced by the tests of Prof. D. A. Abrams, described in *Engineering News-Record* of May 2, 1918, p. 873, many road engineers are barring the use of the wet mixes of past years. Specifications already prepared for considerable mileages of concrete road to be built this year call for mixtures so dry that they must be tamped. It is known that these specifications are but forerunners of others covering the work of whole states.

This change in concrete-road practice is of direct concern to contractors. New and different equipment will be required, and greater working capital will be needed to conduct construction operations.

In these conditions there is no reason for alarm. The danger, if there is any danger, lies in ignoring them. Nor need contractors anticipate a wholesale change to the dry mix in the specifications for this year's road construction. A few specifications will call for mixtures so dry that the concrete must be heavily tamped to flush the water to the surface. Most specifications will call for only moderately stiff mixtures, or for no change until engineers are more fully convinced that the mechanical means for handling abnormally dry concrete are assured. In the end, however, contractors must look forward to the use of drier concrete for road construction, a mixture so dry that it must be compacted by tamping, and they must be prepared to change their practices to meet the conditions.

New Prospects for Improving Rail Steel

WITH the discovery in recent months of a wholly new means for investigating rail quality, a start has been made toward the acquisition of new truths whose magnitude and importance can hardly be estimated as yet. Laboratories all over the country are engaged in examining good and bad rails by etching with strong acid, and they have begun to coördinate the interior conditions disclosed by the acid with failures of rails in track service. It is nearly eight years since the transverse fissure was discovered; yet in that period hardly as much advance has been made toward locating its source as within the past few months.

An appreciation of the power of the new method of study may be obtained from the light it throws on the part played by "bad heats." During the past years of investigation not a few rail men came to believe that fissure troubles reside not in the individual rail but in the ingot or in the heat. Yet this conclusion did not impress itself on all, and further conclusions of possibly great moment were thereby forestalled. With deep etching, however, the parallelism of acid-unsoundness and transverse-fissure troubles appeared early, and further investigation showed a tendency for all or a large part of a furnace heat of steel to be unsound in the acid test. It was natural to conclude that the transverse-fissure danger affected the whole heat or the part which the acid test pointed out as suspicious. Joining this conclusion to the known fact that, in many cases, two or more rails of the same heat had failed in the track, a tentative conclusion has been established that transverse-fissure troubles must be blamed on defective quality of the heat.

Two important deductions follow: First, that if one or two breakages in service give warning against all other rails of the same heat number, possible further breakages (or accidents) may be avoided by taking out these rails at once. Second, that there is more promise in metallurgical studies of rail steel and examination of furnace and mill conditions than in study of track service.

As the facts stood until recently, the case was equally unsatisfactory for both of the opposing theories: That overstress in the track is the cause of transverse fissures and that mill defects are the cause. Against the latter stood the fact that no defects of the steel could be discovered by any known method of examination, as well as the fact that the breaks develop on the gage side of the rail, where the service is most severe. On the other hand, the stress theory was confronted by the unanswerable objection that out of many like rails in a given stretch of track only very few developed transverse fissures. Moreover, light rails often survived where an adjacent rail of heavier section broke—though its stresses were lower; under the stress theory it should not have broken. Furthermore, a rail that had one transverse fissure often, or usually, contained several, and sometimes many, and it seemed undeniable that the material itself, the rail, was defective.

Today it appears clearly established that the stress action—that is, the production of a progressive or detail fracture—does not begin until a steel defect gives it a starting-point. The search is narrowed down to the nature of the defect that causes a star-shaped break, or a "gray spot," or a transverse fissure. Does non-homogeneity of the metal, whether visible under the microscope or not, cause the trouble? Are there cracks in the steel, little discontinuities that never were welded up firmly, and that the acid seeks out and enlarges into sawcut-like gashes? Such questions are likely to be answered soon during the inquiry into what material dissolves out of the gashes made by the acid.

Doubtless, the defects revealed by the acid go back to an early stage in the rolling. Dr. P. H. Dudley's statistical demonstration that rails rolled from reheated blooms do not break seems to make this fact certain. Reheating allows the alloying elements of the steel to diffuse. It also, perhaps, furnishes heat enough for the welding up of cracks that developed in the ingot or during the blooming. But the latter probability is less attractive, in the light of the fact that direct-rolled rails often break; time of heating seems to be the factor, and this means diffusion rather than welding.

So close a similarity exists between the transverse-fissure trouble of rails and the "snowflake" trouble of nickel-steel gun forgings discussed at the American Institute of Mining Engineers' convention a month ago, that the tendency to look for identical causes is but natural. The rail question, however, is more easily solved, perhaps, as an independent study. In discussing snowflakes, in our issue of Feb. 27, 1919, p. 408, we spoke of the essential unity of steel study. It is more probable, however, that rail study will throw light on snowflakes than that the converse should happen. The new acid-etching process gives immediate promise of advance in our knowledge of rail quality.

Cost of Camp Utility Operation by the Construction Division of Our Army

Roads, Buildings, Fire Protection, Electric Service, Heating, Water-Supply, Sewerage and Sewage Treatment with Grease Recovery, Refrigeration and Railroad Service

By George W. Fuller
Consulting Engineer, New York City

THE history, functions, organization and major operations of the Construction Division of our Army were outlined by the writer in *Engineering News-Record* of Feb. 27, p. 416, and the organization set up by the Construction Division to operate and maintain the buildings and utilities at the Army camps was described by the writer in *Engineering News-Record* of Mar. 20, 1919, p. 562. Some of the operating records and costs are summarized in the present article. Efficiency in control of camp water-supply both as to quality and quantity is an outstanding feature. Among the more novel experiences is that of removal of grease from kitchen wastes in order to lessen the difficulties with floating solids and acid fermentation in the treatment tanks at the sewer outlets.

Roads—At the camps and embarkation ports alone there were during 1916 nearly 750 miles of highway. Since early August each camp and cantonment has received an appropriation of $15,000 for road maintenance. In addition to this amount, special sums of from $10,000 to $25,000 each have been alloted in the case of some camps for road reconstruction.

The original specifications call for four standard types of roads, but no single type was adopted in all camps and cantonments. The four used at the various places were bituminous macadam, asphaltic concrete, brick, and cement concrete. The main arteries of traffic were in general paved with one of these types, depending, of course, upon such factors as the availability of materials, the character of construction equipment, the nature of the soil, and the speed of construction. These roads, considering the rough usage which they received, have stood up very well, but almost constant repairs are necessary.

Buildings—Demands for roof repairs have been so great that special study was made to determine the cheapest effective method of making such repairs, taking into account the temporary character of the buildings in other than permanent Army posts. The buildings constructed since the spring of 1917 have for the most part been roofed with two-ply roofing paper. The drying out of decking naturally caused the roofing paper to buckle, in some cases to such an extent as to crack it or pull it around flashings, thus causing leaks. A good deal of damage was also caused to the roofs by walking on them for signal practice, for use as observation posts and similar activities at the camps. In cooperation with the Bureau of Standards, an economical method of roof repairing with plastic cement was adopted, and by the proper use of this material the roofs have been kept reasonably water-tight, at an annual cost of about 10c. per square. At the principal camps alone, for 1918 the average cost of maintenance and repair was $\frac{1}{4}$c. per cubic foot, while the total population housed approximated 1,000,000. On this basis the cost of maintenance and repair of buildings for the six-month period which ended with the calender year 1918 was $4.05 per capita, or $8.10 per capita per year. The total number of individual buildings which have to be maintained is nearly 55,000, with a combined volume of 1,705,625,000 cubic foot.

Fire Protection—As fire marshal, the utilities officer at each large project has organized an efficient and up-to-date fire company for the protection of buildings and stores. The general policies maintained in the design of the camps, of providing an ample number of hydrants and automobile fire trucks, and of leaving "fire breaks" and sufficient space between the individual buildings, has been well justified. At each camp the fire company has been organized at a strength of about 60 men, commanded by an officer corresponding to the municipal "fire chief," who has had experience in municipal fire department work. Similarly, the enlisted men, so far as possible, were chosen for their previous fire-fighting experience.

The fire loss per capita has been kept down to a remarkable low figure, considering the character of the construction. The total fire loss in the Army camps, with average populations of about 30,000 men during the year 1918, amounted to 46c. per capita as against the loss of $2.10 per capita throughout the whole United States. This is noteworthy in view of the fact that the standards of the National Board of Fire Underwriters designate as a low annual fire loss in municipalities one that is below $2 per capita. Thousands of fires, of course, broke out, but only four got beyond the buildings in which they originated, and in each case the camp fire department succeeded in saving a part of the building in which the fire started and a part of the single adjacent building to which it spread.

Electric Light and Power—One of the routine duties of the utilities officer in the field consists of seeing that the necessary generator capacity is actually available at the power station, that the transmission lines are af sufficient size and properly protected, that the necessary transformers and service stations meet adequately the demands, and that the electric energy is properly distributed where it is needed. The secondary distribution circuit, including street lighting, service entrances to buildings, all interior wiring in buildings, together with supplying and maintaining the electric power equipment of the pumping stations, refrigeration plants, laundries, and so on, all falls within the duties of the utilities organization. In the 32 organized camps and cantonments alone electric wiring averages about 1,000,000 ft., or 190 miles.

The average cost to the Government for electric energy has been kept down to about 2.5c. per kilowatt-hour. The cost of electric current varies according to local conditions. At Camp Lewis, Washington, with water-power generation, it costs approximately 0.9c. per kilowatt-hour, while at Camp Mills, with steam gen-

eration and under somewhat unusual conditions, it cost about 7.5c. The average per capita consumption for all camps is about 7 kw.-hr. per month.

Heating Service—In connection with the heating operations, the conservation of fuel has been of great importance. The records of the Maintenance and Repair Division show at 14 central heating plants a saving by careful operation alone of almost 50% of the estimated cost. The estimated daily average of coal required was 360 tons, while the actual consumption was 179 tons. These figures were taken from Northern camps, where the cost of the coal was $8.21 delivered at the boiler houses, and the saving over the estimated requirements amounted to $313,213. Something over 5,000,000 sq.ft. of cast-iron radiation are used in the camps alone. Tens of thousands of room heaters and stoves are used, and all must be kept in good order.

The amount of coal consumed in the camps reaches nearly 2,000,000 tons per year at an average cost of $5.03 per ton delivered, or $10.01 per capita per year. Approximately a third of the total cost consumed in all camps was used to heat buildings. For example, during the extremely cold weather of a year ago Camp Funston used 8640 tons of coal per month for heating purposes alone, and to heat the 2000-bed hospitals at Camp Dix during November, 1918, required 1271 tons.

Control of Water Supply

The average cost of purchased water-supply has been 8.16c. per 1000 gal., varying from 4c. at Camp Doniphan to 17.5c. at Camp Frémont. With an average total daily population in the larger camps of 506,882 persons, from January to October, 1918, inclusive, and a total daily consumption of 26,166,000 gal., the total daily cost amounts to $2135 per day, or $1.54 per capita per year for a daily average of 52 gal. per capita.

In a number of instances the Government maintains a booster station on the force mains in addition to the station at the camp or project, hence there is an additional item of expense. Although precise figures are not available it is estimated that 2½c. per 1000 gal. for boosting is approximately correct. This would make a total cost of 10.7c. per thousand gallons.

In the month of January, 1918, for example, when the peak per capita consumption was reached at the camps, one camp reported the maximum average per capita daily consumption for the month at 123 gal., while another reported the minimum average of 42 gal. The high consumption may be attributed to some extent to allowing water to keep running from the outlets to prevent freezing, and also to central heating plants without return systems. The water-supply in most cases is designed on a daily 55 gal. per capita basis at a pressure of 60 to 85 pounds.

The majority of the National Army cantonments have wood-stave pipe for their distribution mains, some 3,500,000 ft. in all having been laid in the National Army and National Guard camps. At Camp Dix there are approximately 19 miles of water main, one-third of which is cast-iron with leadite joints. There are approximately 25 miles of service pipe, ranging in size from 3 to ¾ in. and about 15,000 water fixtures.

By careful test at Camp Dix it was determined that fixture waste and legitimate use accounted for 400,000 gal. of a minimum night rate of 600,000 gal. per 24 hours. It was also determined that the filling of the railroad water tank accounted for another 100,000 gal. This leaves an unaccounted-for flow of 100,000 gal daily, which may be attributed to underground leaks. At Camp Grant, with a total of 48,840 ft. of main and 55,900 ft. of service pipe, a careful test showed a total underground leakage of 35,588 gal. per 24 hours.

Soon after the camps and cantonments were placed in operation it became apparent that at some the water consumption in winter exceeded the 55 gal. per capita per day basis. Inasmuch as military discipline was commonly supposed to be a corrective for various shortcomings, a campaign of water conservation was undertaken through the issuing of military orders and large posters. But this did not bring about the desired result in all cases. From the very start round-head self-closing faucets were repeatedly recommended by the advisory engineer for water-supply, but for various reasons their use was not then authorized. Since last July self-closing faucets have been used on all new construction.

Attention Directed to Defective Fixtures

Investigation revealed large quantities of water being lost through careless use and defective plumbing fixtures. It was felt that efforts to control this waste would be productive of better results in less time and with less labor than to center major efforts on elimination of the usually small underground leakage.

Some of the more common methods for restricting waste included the lowering of float balls in flush tanks and the reduction of pressure by inserting, back of the faucet, rubber tubing, buttons with two thread holes, glass marbles or tapered lead plugs with small orifices. The latter were inexpensive and easily installed. Since July, 1918, water consumption at practically all camps has been kept within the established quantity.

No case of water-borne disease has so far been attributed to a water-supply installed and operated by the Construction Division.

Sewerage—The construction of 455 miles of sanitary sewers for the 16 National Army camps, approximately 300 miles for the National Guard camps, and approximately 400 miles for various special projects, was an undertaking of no small magnitude. During the 15 months the sewer systems have been in operation very few defects have developed, a rather remarkable fact considering the haste and other unusual conditions under which they were installed

Sewer sizes range from 6 to 30 in. Manholes were designed to be built as cheaply as possible, and were provided with wood covers. During the past summer most of these covers were equipped with locks to prevent the throwing of garbage or refuse into the manholes.

Every effort is made to prevent the access of surface water and the infiltration of ground water to the sewers, particularly at camps having sewage-treatment plants. Utilities officers were instructed to watch for any indication of surface water during periods of rain, and to use every effort in locating any defective sections. Investigations at a number of camps showed that in the haste of construction the manhole tops had not been made high enough and that surface water was gaining access to the system. Orders were issued that all such manhole tops should be raised.

At a few camps trouble was experienced with sand, which found its way into the system through such low manholes as are mentioned above and partly filled the first compartments of the settling tanks. In one or two

instances the trouble was due to defective sections of sewer which had to be relaid. In the few instances where clogging of sewers has been reported, grease has usually been the cause.

Grease—One of the most interesting developments in connection with sewerage at Army camps has been the importance of intercepting grease from kitchens. This subject, up to the time the camp sewage-works were put into operation, had been practically overlooked.

The typical plans at first adopted in connection with sewerage systems at camps provided that an 18-in. tile grease trap should be installed on each kitchen line.

The flow from kitchens comes in sudden gushes. Experiments conducted at Fort Myer by the Sanitary Corps showed that the average flow per capita per day from the kitchens was 2.4 gal. A maximum rate of flow of 1.5 to 2 gal. per capita per hour was observed. However, these sudden gushes cover short periods varying from 5 to 15 min. During a 10-min. interval, therefore, the flow from a kitchen serving 200 men on the basis of the above figures would be from 50 to 67 gallons.

A trap is required of sufficient capacity to take care of these sudden surges, to allow for some cooling of the liquid in passing through the trap, and to permit the accumulation of grease during the period of a week without any great reduction in the capacity of the trap. The tile traps were entirely too small to take care of the peak flows. At such times grease which accumulated in the trap was partly washed out through the outlet. The shape of the trap also has a great deal to do with its efficiency. For instance, the outlet must be so arranged as to prevent as far as possible accumulation of organic matter in the bottom. Traps of the new type installed at the various camps (see sketch) had capacities ranging from ½ to ¾ gal. per capita, based on the number of men served in the kitchen. The early records of quantities of grease recovered indicate that a capacity of ¾ gal. per capita for the latest type of trap is perhaps sufficient. Such a trap requires cleaning weekly.

Camp data from various sources during last autumn show that the quantity of grease recovered per capita per year is about 10 to 12 lb., and the market value of this grease at the present time is about 10c. a pound, or in round numbers, $1 per capita per year. The population of all the principal camps during the past summer was about 1,000,000 men. If all the kitchens had been provided with traps the total potential income per day, on the basis of the above figures, would have been $2750, equivalent to $1,000,000 per year. Thus, the installation of grease traps, instead of being an item of expense, should be a source of profit. However, the money returned is in reality a secondary consideration in comparison with the needs of these traps for protecting the sewer lines and preventing grease from interfering with the proper functions of tanks at the treatment works. Grease trap skimmings contain some water and impurities and will apparently yield about 65 to 70% of grease.

Cold weather promotes the separation of grease, as shown by records from grease traps of various capacities during a period beginning about the middle of November last, as follows:

CAMP MERRITT

Capacity Gals. per Capita	Number of Cleanings	Pounds per Capita per —ea
0 30	3	17 9
0 50	7	7 2
0 60	82	16 1
0 70	22	7 4
0 80	9	11 8
0 90	3	11 1
1 00	12	27 3
2.00	2	77 7
3 00	16	100 1
	156	

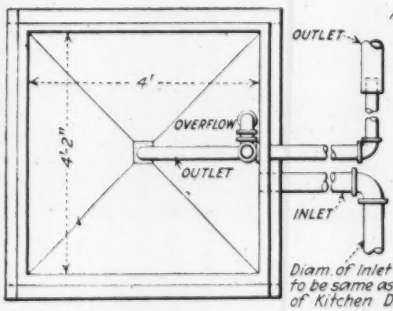
CAMP MEADE

0–0 5	2	11 7
0.5–1 25	143	18 8
1 25–2 00	68	23 2
2.00–3 00	27	69 7
3 00–4 00	25	65 7

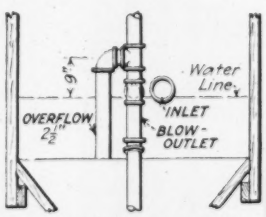
The capacities refer to persons served in the kitchen, to the drain of which the trap is attached. These data show advantages in still larger traps than were installed last summer. At some institutions a trap of 2.5 gal. per capita is favored. More data, especially in regard to summer conditions, are needed.

Tank Treatment of Sewage—Chlorination has been generally practiced at the outlet of the camp sewers, but tankage is the feature most worthy of comment in this article. Briefly, the tanks were unusually small in size, about 10 gal. per capita connected with the sewers. At some plants, as at Fort Myer, Camp Sherman and Camp Custer, septicization became established more quickly and completely than at other camps.

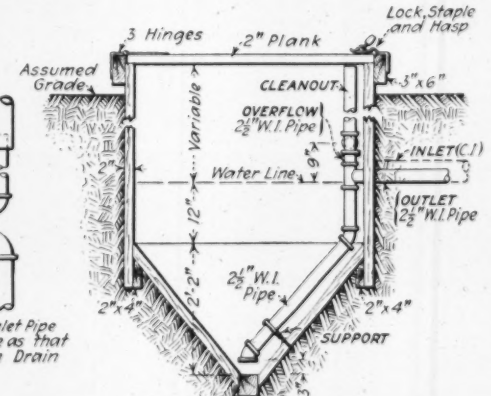
At all plants the freshness of the sewage and the unusual grease content made the sewage solids in the tanks float to a large extent, as compared with the sedimentation more generally noted at city plants. The grease, furthermore, seemed to promote acid fermentation, which generally interfered with prompt and complete septicization.



Plan



Elevation of Inlet, Outlet and Overflow



Section through Grease Trap

Detail of Pipe Support

STANDARD GREASE TRAP AT UNITED STATES ARMY CAMPS AS REVISED BY MAJOR L. S. DOTEN, CONSTRUCTION DIVISION, NOVEMBER, 1918

Absence of funds retarded the program in the spring and early summer of 1918, but solids were removed promptly and carefully, beginning in July. The small tanks have much to be said in their behalf in connection with an efficient operating schedule and adequate grease removal arrangements. Larger tanks (35 gal. per capita) were ordered installed at some of the camps, especially those whose capacity was generally enlarged.

Refrigeration—Data indicate that it costs about $2 per capita per year to operate camp refrigeration plants. These plants comprised a meat-storage room and an ice factory.

Railroad Maintenance—There are 844 miles of railroad at the camps, terminals, depots, etc. Averages of maintenance records show costs of about $1400 per mile per year.

Concrete Consistency Measured by New Device

Method Developed for Concrete-Ship Work Determines Amount of Water to Use in Field Operations

By Herbert A. Davis

Engineer, Concrete Ship Section, Emergency Fleet Corporation

DEVICES to determine the proper consistencies of concrete have been put forward from time to time, but, so far as the writer has noted, none has been put into practical use. In the concrete ships now under construction by the Emergency Fleet Corporation, however, a field instrument has been developed that has proved quite satisfactory.

Soon after its inception the Concrete Ship Section of the Emergency Fleet Corporation recognized that the concrete to be used in the construction of concrete vessels must be of a high quality and special character, due to the relatively thin concrete sections, high steel areas and high working stresses employed for the purpose of reducing the weight of such ships to a safe minimum. Furthermore, it was seen that the concrete for such construction must not only have sufficient strength to meet the high stresses it is called upon to carry, but such concrete must be sufficiently mobile or workable properly to fill the forms and completely embed the reinforcement, with reasonable care and workmanship.

FIG. 1. CONCRETE WHICH DOES NOT DROP IN THE TEST IS TOO DRY FOR PRACTICAL USE

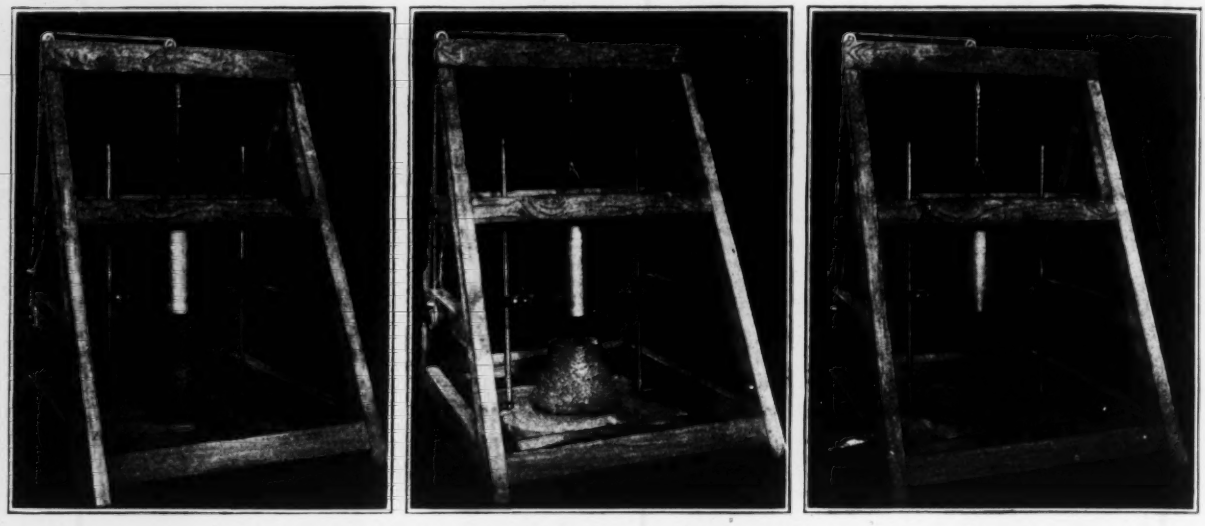
With these factors in mind experiments were made in the laboratory on a large number of materials as aggregates, used in different proportions and with varying amounts of water—that is, with different consistencies. From such studies the aggregates and proportions to be used in concrete-ship construction at various places were established, and data as to the effect of varying the water content of such concretes over a reasonably large range were obtained.

Assuming that all the concrete materials as delivered on the work are inspected to guarantee their quality and uniformity, and that steps are taken to insure the proper proportioning and mixing of the concrete, there still remains the need of a reliable means of regulating the amount of water which the laboratory studies indicated was required to produce a concrete of the strength and workability desired. In the field it has been noted that where the operator judges the consistency of the concrete by means of the eye, such concrete is far from uniform in most cases, and there is a general tendency to use an excess of water far beyond that necessary to give the desired mobility. Furthermore, it has been observed that the judgment of different operators, depending on the superficial appearance of the concrete, as to what is the desired consistency will vary widely.

In an effort to meet this obvious need of a reliable criterion for determining the proper consistency of concrete, the apparatus described has been developed. This consistency apparatus consists essentially of a metal cylinder whose inside surface is perfectly smooth, mounted on metal slides that direct the movement of the cylinder so as to be truly vertical, and this cylinder rests on a smooth glass plate supported horizontally and independent of the supports of the cylinder.

To operate this apparatus, the cylinder resting on the glass plate is filled as a mold with the concrete, the top surface is struck off level and the metal cylinder is slowly raised, leaving the concrete unsupported. It was found that this unsupported concrete took various shapes, dependent on the amount of water used in gaging the concrete. Furthermore, over a considerable range it was noted that the loss in height of the concrete cylinder on removal of the metal cylinder bore a definite relation to the amount of water used in gaging the concrete.

In the original experiments both the loss in height



FIGS. 2 TO 4. CONCRETE CONSISTENCIES SHOWN IN NEW TEST MACHINE

Fig. 2. While probably giving the maximum strength, can only be used in plain concrete work, such as sidewalks, concrete roads, and in large mass work. Fig. 3. Can be successfully used in practically all ordinary reinforced-concrete work, with excellent results. Fig. 4. Suitable for use in concrete-ship construction where it can be placed with reasonable care in spite of the thin concrete section and high steel areas employed in the design of such vessels

of the cylinder and the diameter of the base when left unsupported were measured, but it was found that the loss in height was a much more reliable criterion for determining the amount of water used. The measurements taken of the diameter were somewhat irregular, but in all cases, where care was taken to produce a symmetrically shaped figure, the diameter of the resulting cone was fairly reliable as a measure of consistency

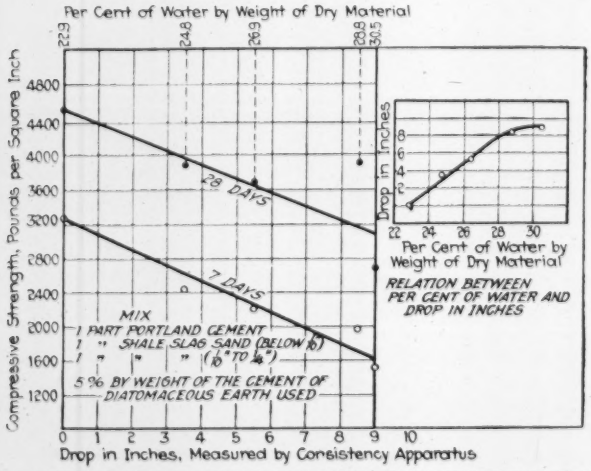
Typical curves, showing the relation between compressive strength, the amount of water used and the loss in height of the unsupported concrete cylinder, as determined by this apparatus for two different concretes, are given.

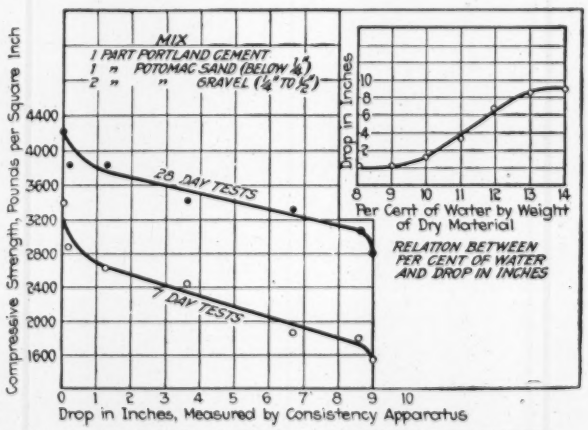
It should be recognized that the aggregates as stored on the work have varying moisture contents, which would materially modify the amount of water needed to produce a given consistency in the field, and further experience has shown that even with mixers equipped with water-measuring devices it is difficult to obtain the same amount of water in each batch. For these reasons it was deemed necessary to measure the consistency of resulting concrete with the "consistency machine" to determine the actual amount of water in the concrete, and to decide, from previously made laboratory studies of such concrete, whether the amount of water used was in excess of that necessary to give the required strength.

Practically, this means that in the field the loss in height of the concrete cylinder as measured by the "consistency machine" should not exceed a given maximum percentage of its original height.

In fixing a maximum limit of drop permissible for the consistency of concrete in the field, the general tendency of contractors to use an excess, rather than too little water, was in mind. It is believed, furthermore, that a certain amount of freedom should be permitted the contractor in this matter of consistency, provided he does not produce a concrete that is too wet. Accordingly, in the field work the effort was made to secure a concrete in which the drop was approximately 75% of the original height of the cylinder—that is, nine inches.

The consistency of the concrete which has a drop of 9 in. as measured by this apparatus, for mixtures sim-





FIGS. 5 AND 6. EFFECT OF WATER ON CONCRETE CONSISTENCY AND DROP AS SHOWN IN TESTING MACHINE

ilar to those used in the construction of concrete ships, may be described as semi-fluid or very mushy.

This method of controlling the amount of water used in the concrete has been tried out on practically all the ships or barges constructed to date, and it may be said to have accomplished with a reasonable amount of success the purpose for which it was designed, as attested by the results of tests made on the concrete cylinders taken from the work. This was accomplished with little or no interference with the work, and in general the consistency of concrete as regulated in this manner satisfied both the contractor and the Government representatives.

The author wishes to express his appreciation to G. V. Marconi and Watson Davis, of the Bureau of Standards, for assistance given in obtaining some of the data published in this article.

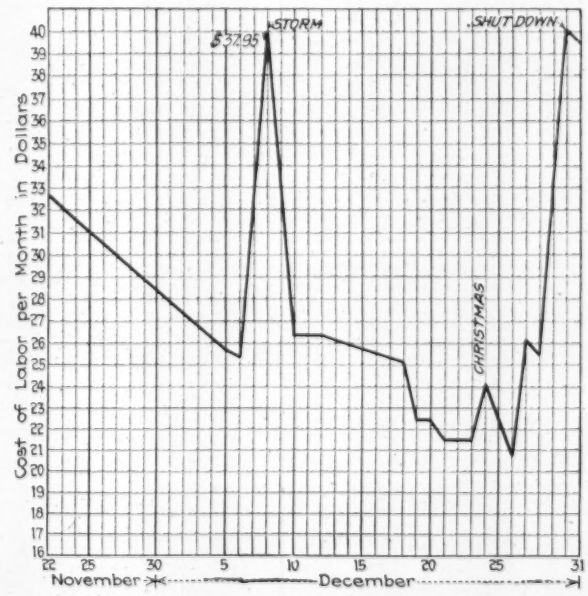
Unit Costs Lowered Without Cutting Wages

By J. B. Lippincott

Consulting Engineer, Los Angeles, (recently engaged in war work in the East)

During the war, high unit costs of construction have been due to the low output per man-day rather than to high wages, though the latter is, of course, a factor. Whether the bricklayer is paid 65c. or 85c. per hour is less important than that he has reduced his output from 1000 to 300 bricks per day. The experience here related and illustrated in the diagram shows strikingly the effect of increasing output, for the wages were not changed.

The incident is all the more important because the present inactivity holds grave possibilities, a fact realized by the Government, financiers and others. Labor is organized because it has to be for its own existence. It has taken advantage of its opportunity during the war to advance its rate of pay. I believe from personal contact with the unions that the skilled trades will not reduce that scale. The wage of common labor probably will go down, as it is not organized. However, *it is more important that wages be stable than that they be lower.* As compared with war conditions, overtime, which is paid at the rate of time and a half or double time, has been eliminated. This means a substantial reduction in the average wage rate per hour. I believe mechanics will endure much and go hungry a long time before they will reduce their scale. On the other hand, it is folly for them to try now under existing conditions to ask for an increase. It should be the problem of all to work for a resumption of business and to avoid placing any obstructions in the way.



COST OF BRICKWORK JOB ON ATLANTIC SEABOARD, NOVEMBER AND DECEMBER, 1918

The diagram shows the decrease in the labor cost of laying brick at a point in eastern Pennsylvania, following the signing of the armistice. The wage was 87½c. per hour. The writer was assigned to this work Nov. 16. The project was suspended Dec. 27; consequently, the unit costs cannot be given for a greater range of time. The costs were averaged for the week. The sharp rise Dec. 10 was due to interruption of the work by storms. That on Dec. 27 was due to the shutdown. Christmas week also shows a peak.

This diagram is fairly typical of other decreasing costs. The general decrease was brought about as follows: Overtime was eliminated as labor became more abundant. The personnel was much improved by a process of segregation. Those that remained did more work. The output per man-day was nearly doubled. The cost in November (1918) was outrageously high. It remained too high by far when the job was shut down from Washington, but there was a reduction in labor costs from $33 to $20 in 37 days. This reduction in cost was accomplished during a period of increasingly bad weather and in spite of much rain and bad roads. If the work could have been continued through to spring weather the reduction would probably have continued down to a reasonable unit cost. *No reduction was made in the wage.*

The union local and state officials took a keen interest in assisting in improving the unit costs. They realized that this should be done in order to encourage resumption of normal conditions. They also appreciated that if improvements were not shown by their trade other trades would supplant them—for example, that concrete buildings would supplant brick structure. In other words, the union in this case was an agent in helping to improve conditions.

This experience is a suggestion for reducing unit costs elsewhere, a move essential for the resumption of building. It is difficult to accomplish, doubtless, but probably far less so than to attempt to reduce the wage scale. Moreover, the possible results offer greater opportunity for larger cost reductions. The most effective way to reduce these costs is to adopt a piecework policy. If this is untenable, then the establishment of a reasonable day's output per man should be sought. At least in one case organized labor coöperated in this policy.

It is to labor's interest to assist in establishing efficiency so that it may not be vitally necessary to reduce the wage scale or defer starting new work.

Stream Flow Article by C. H. Pierce

The article "New England Rivers Have Similar Run-Off Characteristics," in *Engineering News-Record* of Mar. 20, 1919, p. 577, should have been accredited to C. H. Pierce, district engineer, United States Geological Survey, Boston, Mass., as author.

Railway Engineering Association Has Active Meeting

Tentative Rail Specifications Mark New Views of Quality and Tests—Rail-Joint Test Methods Adopted—Proposed Bridge Specifications to Be Reconsidered—Large Attendance and Atmosphere of Coöperation

IMPORTANT progress in technical railway matters, progress made despite unfavorable conditions, was put on record by the annual meeting of the American Railway Engineering Association at Chicago last week. In the fundamental subject of rail quality and rail testing a new field of study was opened up, and improvement of the specifications for rails to apply the new views was begun. Even more active work centered on the subject of steel bridges. A radical revision of the standard bridge specifications was worked out during the year, but the association, at its meeting, decided that it could not be accepted without full consideration, and referred the draft back to the committee for another year.

Significant of the unusual success of the meeting was the record-breaking attendance. Over 500 members were registered, a number considerably higher than at any previous meeting. In part, this is credited to the action of the Federal Railroad Administration, which, recognizing the importance of the technical studies carried on by the association, urged the various Federal managers to induce as many members as possible of the engineering organizations to attend.

The atmosphere of the meeting expressed the unusual character of present railway conditions and the exceptional importance of the railway engineering work that must be done during the next few years. President-elect Earl Stimson brought this matter to the fore in his inaugural remarks at the close of the meeting, in urging the technical committees to early and energetic attack on the problems submitted to them.

Relations to Railway Managers and to Manufacturers

New conditions will surround the association's work henceforth, due to the formation last month of the American Railroad Association as a consolidation of and successor to several executive and technical railway associations which heretofore covered the field—the American Railway Association (executives), the Master Car Builders' and Master Mechanics' Associations, and others. An engineering section of the new American Railroad Association has been created but the Railway Engineering Association will remain independent of it, though actually furnishing the substance for the recommendations and conclusions which that section will report to the larger body.

More coöperative relations to manufacturers have also come into fairly definite prospect. President C. A. Morse, in his address to the meeting, laid special stress on the results accomplished by the committee on track, in working out new standards for frogs and switches in collaboration with manufacturers. It has been the policy of the association in the past to restrict its committee membership rather closely to railway men, in sharp distinction from the policy of the American Society for Testing Materials in balancing its committees as between producers and consumers. The spirit of President Morse's words may lead to a liberalization of the committee work in this latter direction, and some steps of the kind have already been taken by the rail committee.

An outstanding feature of the rail committee's report is a new method of studying rails for interior defects, contained in a series of reports on special investigations. The method consists of etching horizontal sections of the rail head with strong acid, hot, for several hours. It produces remarkable pitting or fissuring in certain rails, and all observations so far indicate that this pitting and the occurrence of "transverse fissures" in the rail while in track service are intimately related. Studies of defective rails by the "deep-etching" method are being made in rail laboratories all over the country at present. A brief summary of the subject is given in another column.

Among the other special-investigation reports presented by the committee are: Tests of various splice-bars (summarized on page 611), the quick-bend test by W. C. Cushing, interior transverse fissures by P. H. Dudley, and a statistical study of the service obtained with narrow-head rail (the so-called frictionless rail) on curves. This rail was found to be in use on about 25 roads, with results that are in general satisfactory, the rate of rail wear being reduced in most cases.

Besides these several matters covered by the report of the rail committee, there was discussion of the relations of wheels and rails by the track committee and on curve wear of rails by the committee on economics of railway location.

Proposed Rail Specifications Raise Quality and Provide New Test

Small but important changes in the association's specifications for steel rails, proposed by the rail committee, led to a call for coöperative work from the manufacturers' rail committee. The changes would (1) result in harder rails; (2) make more severe the criterion of acceptance of rails, and (3) establish a radically new form of test as an alternative to the time-honored drop test. The practicability of furnishing rails under existing mill practice would thus be affected, and, as stated by the manufacturers' committee, the mills have had no opportunity to consider the new test and acceptance requirements properly. In acknowledgement of this fact, a joint meeting of the two interests is to be arranged for, where differences of view may be considered and ironed out. The proposed specifications are in the meantime to be published only for consideration and discussion during the coming year. The essential changes from the present specification are the following: The required percentage of manganese in open-hearth rail of all weights is raised by 0.10%, making the limits read 0.70 to 1.00%. For the heavy weights of open-hearth rail, 111 lb. per yard and over, the required amount of carbon is raised by 0.05%, to the figures 0.67 to 0.80%. Both changes mean harder rail. At the same time, however, a higher ductility is demanded, the elongation (in drop test) being

changed from 6% to 8%. Furthermore, acceptance is made less easy by the requirement that all three drop (or bending) tests representing a given heat must pass if the heat is to be accepted.

Hitherto, the drop test has been the determinative physical test of rails. Experience on the Pennsylvania R.R., however, has developed so clearly and convincingly the value of a bending test made in a hydraulic press, that the committee adopted this test as an alternative to the drop test. The bend test is specified to be made with a 350-ton press on a 48-in. span, and autographic records of load and deflection are to be taken; the test is to be made preferably with the rail head in tension.

The specifications contain an unusual "information" clause, which states that transverse fissures have been more numerous in the product of mills that roll rails direct from the ingot than in material rolled from reheated blooms; it also states that six mills reheat the blooms and eight roll direct. The clause makes no recommendations or requirements, but contains a note stating that it is given merely as information derived from the statistics of rail failures.

Standard Specification for Tests of Rail Joints

Elaborate experimental studies of the strength of rail joints made by the Altoona laboratory of the Pennsylvania R.R. brought out so much valuable information concerning rail joints that the Rail Committee formulated a specification of test methods for rail joints, with a view to securing comparable results from tests made at different laboratories. The test is to be made in a press, the rails being supported on two supports 48 in. apart and the load applied over the joint midway of the span, measurements of deflection and set being made at 3000-lb. intervals of load. From the results of the test the efficiency of the rail joint is to be computed as the ratio of the elastic limit of the rail joint (in pounds) to the elastic limit of the continuous rail. This efficiency is to be stated both for head up and for head down. Furthermore, the rigidity of the joint is to be stated, expressed as the ratio of the deflection at the elastic limit of the joint.

By vote of the meeting this test specification was adopted, and is to be included in the "Manual."

Under the chairmanship of O. E. Selby, the committee on iron and steel structures studied and reported on several bridge subjects. By far the most important of these was the association's standard specification for steel bridges, which was first adopted in 1906 and was slightly revised several years later. Wholly new specifications were drafted by the committee.

They differ externally from the old ones in being much more elaborate as to design details and workmanship, having nearly twice as many clauses. A new train loading is specified—Class 60 in place of Class 50—but the Cooper type of engine and train is retained. The Turneaure impact formula is substituted for the old Schneider formula. Secondary stresses are taken into account. Reduction of live load on multitrack bridges is allowed. Reversed stresses are treated in a new way. A parabolic column formula is substituted for the old straight-line formula, and the limit of 12,000 lb. per square inch is fixed as the basal figure of column loading in place of the former 14,000 lb. In all parts the proposed specifications represent a wholly new departure from the old. However, they were printed so late that they did not reach the members of the association until two days before the convention, so that study with a view to adoption by the meeting was impossible. For this reason, after discussion on the floor revealed serious differences of opinion, the committee's motion that the new specifications be adopted in place of the old and printed in the "Manual" as standard was declined, and the subject was referred back for reconsideration during the coming year.

Remarkably broad discussion developed, in spite of the late printing, and points of fundamental importance to bridge design were raised. A few notes follow.

W. H. Courtenay questioned the ambiguity of the requirements as to lateral forces, wind effects being apparently omitted from an important clause. F. E. Schall asked whether the new specifications will produce weaker or stronger bridges than the old; until careful study can answer this question, they should not be made standard.

Referring to the clause reducing the live load on multitrack bridges, J. J. Yates suggested that the center girder in a 100-ft double-track bridge will be burdened with 70% impact under the new clause, as against 60% under the old. The new would increase both floor and girders, but experience shows that many floors are weak while the girders are still adequate.

A wholly new basis of design was advocated by A. C. Irwin, a member of the committee but not in agreement with its conclusions. He urged that bridges must be designed with a view to carrying the heaviest loading likely to come on them, and that designing for an artificial loading without much margin over present-day railway service makes it necessary to use low unit-stresses, the latter giving the margin necessary to provide for future load increase. An unbalanced bridge is the result, and one that is not designed for the heaviest load that may come on it. The cure for this condition is not the proposed specification, but one that will provide for the heaviest possible loading and allow the highest unit-stresses for this. With low unit-stresses there is continual trouble from the effect of the ratio of dead load to live load. Mr. Selby replied that these arguments had been considered very carefully. The committee recognized that low unit-stresses do not give a balanced margin for live-load increase, but gave heed to the psychological effect of specifying very high dead-load stress and an enormously increased live load.

The Proposed Specifications Criticized

E. A. Frink, characterizing the proposed specifications as an admirable piece of work, said that many serious faults need to be corrected. The loading adopted is the principal point of trouble. With Class 60 the engine loading is about 8800 lb. per foot, while heavy Mallet engines give about 8000. For present service the use of Class 60 gives an uneconomical bridge, with too much metal in the trusses and too little in the floor, in long spans. It is time to adopt a loading nearer the actual than is the Cooper series; the association should devise a new standard loading.

Moreover, it is questionable whether a loading as high as Class 60 should be prescribed. Such a capacity is not needed everywhere, and even Class 50 is not needed in some regions. In view of the great influence exerted by a bridge specification printed in the

"Manual," it will be hard for a bridge engineer to use a lower loading than Class 60 even if the conditions on his line justify it, and for this reason the best course might be to omit specifying a standard loading. In that case, the specification would say that bridges should be designed for the actually used train loads, with a given margin for probable increase of train weights. Mr. Frink also criticized the stresses in crossties as too high, and commented on the enormous loading specified for floors composed of transverse beams —over 25,000 lb. per linear foot of track, static equivalent.

Criticism was presented also by P. B. Motley, although a member of the committee. He asked that the specifications be referred back for further consideration. The new specifications of the Engineering Institute of Canada, drawn up under his chairmanship, were arranged to present successive subjects in the order of design, and differ in arrangement from the proposed specifications. It is necessary to have a Canadian specification to which Government bureaus can refer by name, and though it is desirable to have it agree with the American, this result could not be reached during the past year. However, there should be no international boundary in science.

European Plan Is Suggested

After dealing with several specific points, Mr. Motley said that he largely agreed with Mr. Irwin, and felt that the specifications "are not yet down to brass tacks in design." If the Mallet engine were to be adopted as basis of bridge loading now, we might have a quite different engine in ten years. It may therefore be wise to adopt the European plan of designing for a wisely selected uniform load.

Prof. F. E. Turneaure, speaking for the committee, dealt with the question of basing design on ultimate (maximum) unit-stresses.

Some years ago the association adopted 26,000 lb. per square inch as the stress defining the limit of safety of an old bridge. The committee considered whether this method could be applied to the designing of a new bridge; thus, 24,000 lb. per square inch. (or 22,000) might be used for the dead load and for the ultimate future live load, taking for the latter a loading that might exist 30 or 40 years hence. If the live-load stresses were properly increased by impact addition, this method would give a balanced bridge. But, Professor Turneaure asked, is 24,000 a safe figure to place before engineers as the allowable unit for static loading? We now use 16,000. The committee did not feel that it could substitute 24,000 for this figure. And the same view held against accepting 22,000, or even 18,000, as an allowable dead-load unit-stress. The resulting conclusion is what the proposed specifications embody, namely, 16,000 lb. as dead-load tensile stress.

Unbalanced design is guarded against by a clause which requires web members to be designed for two-thirds dead-load stress plus 1½ of the live-load stress plus impact. A span of 200 ft. so proportioned will have webs and chords of uniform strength; a shorter span has the web system stronger, while a longer span has its chords stronger.

A special proviso limits the proposed specifications to spans not over 300 ft. long, as B. R. Leffler pointed out. Longer spans, in his opinion, are subjects of special design. Unbalancing is guarded against not only by the clause quoted by Professor Turneaure, but also by a clause which requires that in ballasted-floor bridges only three-fourths the floor weight shall be considered.

Other Work on Steel Structures

Specifications for movable bridges presented by the committee a year ago and printed in the *Proceedings* are still under advisement. Revision has been considered, but few comments or criticisms have been sent to the committee. A special request for such assistance was made at the meeting, in order to permit the carrying out of the revision this year.

No experimental work on impact and secondary stresses was done during the past year. The research is now regarded as concluded, and the subcommittee on the subject has been discharged. The conclusions already reached "are not likely to be modified by any further work of that kind which the committee might be able to do in the near future." Column testing, however, is to be continued, and steps have been taken to enlist the help of the Bureau of Standards, now that its war work is closed.

Plastic compounds for protecting structures of steel and concrete from the blast action of locomotive exhaust are being studied. Some experimental applications are under observation, but no report was made. Waterproofing is also to be worked on during the coming year.

Track-scale girder designs which had been prepared by the committee on yards and terminals were approved by the committee on iron and steel structures. They cover the design data and the girder sections for three sizes of track scale.

Improving the Quality of Concrete

Carrying forward his tests on excess water in mixing concrete, Prof. D. A. Abrams has obtained a large number of results confirming and supplementing his findings given in *Engineering News-Record* of May 2, 1918, p. 873. These additional results were presented by him in a paper forming an appendix to the report of the committee on masonry. Wear resistance, Professor Abrams found, is almost exactly proportional to strength. Both strength and wear resistance are greatly increased by limiting the amount of mixing water to a much lower point than common practice allows. Attention to the conditions of seasoning of the concrete is also important. Concrete made under favorable conditions as to consistency and curing showed an increase of 275% in compressive strength and 240% in wear resistance over concrete made under distinctly unfavorable conditions.

Prof. A. N. Talbot, in discussing this paper, gave a careful analysis of the factors correlating the moisture conditions, the mixing operation, and the strength of concrete. He called attention also to the effect of moisture on concrete that has been cured under insufficient supply of water. The later supply gives a great gain of strength. Some specimens in dry storage that were under observation and test for various ages showed at 7 years 3 months a strength of 3000 lb., but when thereupon placed in moist storage for 9 months they had a strength of 5000 lb. per square inch. However, while the supply of moisture during seasoning is vital, surface sprinkling may be ineffective and is often over-rated.

Discussing the time of mixing, B. R. Leffler stated it as his conclusion that the proper time for good mixture and adequate mobility of the concrete depends on the type of mixer. A time of 1 min. may be satisfactory for certain types of mixer, especially those of ½ cu.yd. and smaller, but not enough for others. From his experience, however, it is believed that many contractors are likely to protest strongly against a 1-min. mixing time.

Track Questions

Unsatisfactory relations between rails and wheels were indicated in the report of the track committee. The opinion was expressed that the present heavy wheel coning of 1 in 20 has disadvantages, and that the coning which gives minimum wear of wheels—which was the purpose of changing from 1 in 38 to the present 1 in 20—is not a condition favorable to economical wear and least stress of rails. Furthermore, a 1 in 20 canting of the rail is considered too steep an inclination, as it conforms to the present wheel coning and thus practically nullifies the objects aimed at in this coning.

Possible injury to rails by flat spots on wheels led the track committee to recommend that the present 2½ in. limit of length should be reduced to 1½ in. The impact effect increases with heavier and stiffer rails or with rigid, frozen roadbed. C. E. Lindsay, of the United States Railroad Administration, pointed out that the likelihood of damage by heavily loaded wheels having long flat spots is not generally realized. The recommendation was adopted and will be submitted to the Master Car Builders' Association with a request for the reduction of its present 2½-in. limit.

Cost of Curvature

A change in methods of valuating rail wear on curves was suggested by the committee on economics of railway location, in a statement to the effect that rail wear on curves, as compared with tangents, increases approximately as the square of the degree of curve. The importance of this was stated to be evident from the fact that heretofore it has been customary to estimate curve expense directly with the central angle, or with the degree of curve when a different length is considered. Individual experiences with rail wear on curves were brought out in the discussion.

Consolidation of the subgrade by a 10-ton roller to prevent water pockets in the roadbed was advocated by the roadway committee, which also suggested methods of curing such pockets by drainage and filling with porous material, while concrete filling for such pockets and wet spots was suggested by the ballast committee. Concrete-slab construction to carry the ballast was discussed by the latter committee, but it did not include the extensive experiments on the Northern Pacific Ry. which were described fully in *Engineering News-Record* of Dec. 12, 1918, p. 1071.

Screw Spikes

Screw spikes appear to be showing less favorable results than was anticipated a few years ago, when they began to be used to any large extent. Doubt as to their value in increasing the durability of ties was expressed by the tie committee, except under such special conditions as on elevated structures and in track having a more substantial foundation than the ordinary tie and ballast construction. It was explained by F. Boardman of the N. Y. Central R.R. that this statement was based on unfavorable reports from most of the roads using screw spikes.

As an offset to this statement, however, extended and favorable experience on the Delaware, Lackawanna & Western R.R. was recorded by G. J. Ray, formerly chief engineer. On a 30-mile stretch of double track laid in 1911 the only spikes which were loose after eight years' service were those in about 100 ties which proved to be rotten. A standard form of thread is important, as the replacement of one spike with another having a different pitch and form of thread will destroy the threaded groove in the wood, and after a few such replacements there will be no effective hold of the spike.

Expansion of the present allowable working stresses for structural timber to include treated timber is inadvisable without further experiments on treated and untreated timber in large sticks. This conclusion was presented by the committee on wooden bridges and trestles. Tests indicate that neither the character nor the quality of the preservative causes any appreciable decrease in the strength of timber, but that such effect is due entirely to the process of treatment and that this may affect different timbers in different degrees.

Zinc as an Alternative for Creosote in Treating Railway Ties

ZINC-CHLORIDE treatment for railway ties is justified where, for economic reasons, creosote oil is not available, or where conditions of maintenance will not warrant the expense of application of the latter. Furthermore, zinc treatment will secure at least double the life given by an untreated tie of the same kind in the same location, no matter whether oak or pine is used. In dry climates this increase in life may be still greater. These conclusions are given in the report presented by the wood-preservation committee at the annual meeting of the American Railway Engineering Association. The committee frankly says that creosote is the best timber preservative for all purposes, but points out economic limitations to its use.

Climatic conditions qualify the above conclusions favorably to zinc chloride, the Eastern and Southeastern states generally being excluded from the field for zinc-treated ties. Introduction of some lubricating agent with the zinc, to correspond with the action of creosote oil, is recommended where excessive rainfall and humid atmosphere would cause the zinc in the ties to be influenced unfavorably by leaching; also, where checking of the timber or its mechanical wear is likely to be excessive, but where it is not possible to secure a straight creosote treatment.

One of the objections urged against the use of zinc chloride has been that, as the salt is soluble, it will leach out of the wood by moisture and cannot be expected to give permanent protection. The committee finds, however, that leaching does not take place as rapidly as has been assumed. In ties which have been in the track for several years, especially in the drier climates, the zinc chloride has been found well distributed through the wood.

Air seasoning for 60 days after treatment is recommended, as it results in greater strength of the tie, increased resistance to wear by spikes and tie-plates, less leaching of the zinc, and less disturbance of signal circuits by leakage of current from the rails.

Progress in Study of Rail Quality

American Railway Engineering Association Research—Deep Etching of Longitudinal Sections of Rail Head Brings Out Network of Lines Present Before Rails Are Straightened—The Quick-Bend Test

EXTENSIVE studies of rail quality made during the past year under the direction of the Rail Committee of the American Railway Engineering Association led to results that represent marked progress and give a distinctly better understanding of rail troubles. An important factor in the matter was that, due to the increasing interest in the subject on the part of the railroads, more investigators worked on the problem than ever before, according to a statement by P. H. Dudley of the New York Central Lines. "This is due," says Dr. Dudley, "to so many officials of the railroads having found from the service records that some brands of rails in the track had a large number of failures, while other brands rolled under a different mill practice did not have one failure in the same section, though subject to the same wheel loads and tonnage."

Three prominent points of the new research work are: (1) The discovery of the value of deep etching with strong acid to bring out hitherto unrecognized defects in the interior of the rail head; and the discovery through such etching that defective rails show a startling degree of non-homogeneity, streaks running in various directions through the rails; (2) statistical proof that rolling rails direct from the ingot contributes to the production of transverse fissures in the rail; rolling from reheated blooms is a preventive; (3) study of a new toughness test for rails, a bending test in a hydraulic press, as a substitute for the drop test, long the traditional standard of rail acceptance testing.

Depp Etching Brings Out Extensive Flaws

F. M. Waring, engineer of tests at the Altoona laboratory of the Pennsylvania R.R., last summer developed the use of deep etching with strong mineral acid to bring out defects in longitudinal sections of rail heads. This laboratory and the rail officials of the Pennsylvania system have for a number of years centered their attention on non-homogeneity of rail metal as a responsible cause of rail failures, and in this line of thought some years ago decided that chemical analyses of samples from different parts of the cross-section of the rail must not show large variations of composition, if the rail is to be regarded as satisfactory. Pursuing the same line of thought, laboratory studies were made to discover indications of unsoundness, by etching longitudinal horizontal slices cut from the heads of rails and carefully smoothed and polished. The usual micrographic etching solutions did not bring out any special appearance, although this method in some prior cases had revealed hair cracks in the metal. It was then decided to use a more drastic etching process. Trial was made of successive etchings in a number of the solutions, still without result. But very definite results were attained when the specimens were etched for two hours in hot, strong, mineral acid (nine parts of hydrochloric acid, three parts sulphuric acid, and one part of water, kept at 200° F.). This brought out a remarkable number of longitudinal, transverse and irregular marks or depressions. These marks, representing streaks of more soluble material, proved the existence of serious non-homogeneity, likely to lead to irregular stress distribution in the rail and therefore create opportunities favorable to cracking in service.

These deep-etching studies were applied to a number of rails that had developed transverse fissures in the track (or in some cases while being tested), and the same irregular markings were found in nearly all cases. On the other hand, a rail that performed well under the drop test, though made from the same heat of steel as a number of the defective rails, showed uniform metal when etched by this method. Mr. Waring in a report to the railroad company says, "Since these rails were all from one heat, of a fairly uniform chemical composition, and rolled at the same time, and since they were all subjected to approximately the same amount of service in the track, it would appear as if these defects found in the rail heads are associated in some manner with the process of manufacture."

Trial was then made to see whether similar defects could be found in a rail that had never been in service. The deep etching with mineral acid brought out the markings, though picric acid etching had failed to develop anything unusual.

"An examination of all these deep etchings," says Mr. Waring, "brings out the fact that these small internal transverse ruptures correspond in their location and appearance with the nuclei of transverse fissures, and it is possible that they may be the original cause of such fissures."

Closely related to this investigation is an observation made by J. B. Young, chemist of the Philadelphia & Reading R.R., a few months ago. Test specimens cut from the center of the head of a 100-lb. rail that had never been in track, and had not even been on the hot bed, showed cracks in various directions through the metal. The cracks were noticed after the standard test specimen was fractured in the testing machine. Hitherto, many rail experts have believed that small cracks are produced in the rail head during the straightening process, in the gag press, but in the present case there had been no gagging or other straightening. Mr. Young therefore holds that his findings "are conclusive evidence that flaws and cracks exist in new rails which have been subjected to no strains except those developed in the rolling."

Reheated Blooms Make Good Rails

Reporting on the subject of transverse fissures, Dr. P. H. Dudley, consulting engineer, New York Central Lines, brings sharply into view various discrepancies of fact that have surrounded the two opposing theories on the cause of transverse fissures. As against the theory of James E. Howard that repeated stresses in track service produce the transverse fissures (as fatigue fractures), Dr. Dudley directs attention to the fact that the nucleus is not a point but is of measurable size, and, from its appearance, obviously resulted from a process different from that of the rest of the area. He emphasizes the fact that such fissures occur only in an occasional rail head, although design, traffic conditions, and stresses are alike for many rails, and there-

fore, if stress is the cause of the fracture, most rails should break in the same way.

That transverse fissures in their development are fatigue or detail fractures is conceded by Dr. Dudley: "There is no difference of opinion about the growth in the track of the specular surfaces which start from and around the nuclei of interior transverse fissures." What fault or flaw at the nucleus gives opportunity for the transverse fissure to start remains the essential problem. Dr. Dudley refers to the discoveries of Mr. Waring and Mr. Young, above mentioned and to the discovery of streaks of high-phosphorus metal in defective rails by George F. Comstock as reported in *Engineering News-Record* of Mar. 13, 1919, p. 532. Without expressing an opinion on these discoveries, however, he brings out other facts on the influence of reheating the steel before rolling.

Statistics prove, Dr. Dudley shows, that about all transverse fissures occur in rails rolled direct from the ingot, while rails from reheated blooms virtually never fail in this way. This appears to establish beyond question that qualities or defects of the steel are responsible, rather than excessive stress.

The service records of eight railroads for the seven years 1909-1915 exhibit a total of 559,644 tons of rail produced by direct rolling; in these rails 1054 transverse fissures developed. The same road had 322,593 tons of rail made from reheated blooms, and these developed only 59 transverse fissures, or less than one-tenth as many per ton of rail as by the direct-rolled material. The rails were rolled at 11 mills, and thus represent a large variety of mill conditions. Moreover, 27 of the 59 failures of rails made from reheated blooms came from a single mill, and are said to have been rolled at a time before the mill practice was made uniform and good. It should be mentioned that the whole group of statistics concerns only heavy rails; that is, rail weighing 100, 101 and 105 lb. per yard.

Whether finishing the process of rolling the rail at a low temperature is advantageous was also studied by Dr. Dudley. Some years ago it was a common charge that steel rails were put through their finishing passes too hot, and thus did not go through the grain-refining process which cooler rolling would have brought about. Dr. Dudley cities experiences showing that a low temperature in the last pass of the rail mill is apt to produce brittleness. This brittle metal is capable of being restored to a tough condition by annealing. General experience leads him to conclude that chemical composition has an important influence on toughness or brittleness, and he concludes that steel with more than 0.85% carbon is particularly likely to have its toughness destroyed in the rolling or in the cooling of the rails on the hot beds with the effect of producing brittleness.

Surveys of rails by a magnetic tester to detect internal flaws were made by Dr. Dudley recently. He gives no detail results, but states that the leakage curves of rails obtained with this apparatus furnish much information about the physical properties in rails and about the disturbance of the metal by the gag press used in straightening it.

Rails are tested for acceptance by the Pennsylvania R.R. by means of a press bending test in addition to the regular drop test. The press is in a hydraulic machine operated by an intensifier standing alongside, and capable of exerting a pressure of 378 tons. The main ram is 16 in. in diameter and has a 12-in. stroke. The machine weighs 11 tons. The supports for the rail, under the press ram, may be set at various spacings; tests have been made with supports 24 to 51 in. apart. A hydraulic pressure indicator records on a drum turned by a connection with the main ram, so that an autographic diagram is produced.

Deflections at ultimate load of rail specimens bent in this machine are found to be an indication of the ductility of the material, just as well as is the elongation in the drop test of the rail. It is also belived that the deflection is in a measure an indication of the toughness of the rail, or rather its capacity to resist shock.

Tests made with the head down (in tension) gave more satisfactory and uniform results than those made with the head up. In the former, breaks were obtained in nearly all cases, while with the head up the breaks were apt to be branching or irregular. Furthermore, the tests made with different lengths of span of the rail showed closer agreement between the test results and theoretical curves, for the tests with head down than those with head up.

One of the striking results of tests with the bending machine brought out in a report on the subject submitted by W. C. Cushing, chairman of the subcommittee on the quick bend tests, is the distinct superiority in quality of the rails produced by one mill as compared with those of another. A large number of tests of 130-lb. rails from three mills, plotted to show elastic limit as ordinates and ultimate deflection as abscissas, placed the rails from one of the three mills in a group distinctly above and to the right of the groups representing the other two mills. This comparison shows greater ductility and strength, on the average, for the rails of the first mill, though all were rolled to the same specification and the same section and weight.

In another experiment, a rail that failed in the bend test at a small deflection—in other words, was brittle—was retested after annealing, and the deflection was increased more than four times, indicating a curing of the brittleness by the heat treatment.

Rail-Joint Tests Show Heat Treatment and Short Bars Advisable

THAT plain angle bars, if heat treated, can make a rail joint having strength and efficiency equal to that of the solid rail, is the important conclusion of a report submitted by the rail committee of the American Railway Engineering Association as an appendix to its own report. This rail-joint report was made in 1915 by C. D. Young, then engineer of tests of the Pennsylvania R.R. It was based on tests made at the Altoona laboratory covering different forms of plain angle bars, splice bars with stiffening flanges depending below the rail and joints giving a base support to the rail.

Heat-treatment results constitute the main feature of the report, showing an increase in elastic limit ranging from 60% in solid 100-lb. rail to 79% and 150% in plain angle-bar joints with six and four bolt holes, respectively. In the rail the elastic limit was raised from 175,000 to 280,000 lb., while in the bars it was raised from 70,000 and 50,000 lb. to 125,000 lb. in both cases. From this the conclusion was drawn that heat treatment was one of the simplest and most economical means of increasing the efficiency of the joint.

The treatment mentioned consisted in heating the material above the recalescence point (approximately 1500° F.), quenching in water, and then annealing the hardened steel at about 1050° F. It was estimated at that time (1915) that this should not add more than $5 to the cost of the steel, while it would increase the stiffness of the bar at least 50% and still leave the metal softer than the rail.

Mr. Young pointed out that a joint equal in efficiency to the solid rail could be obtained by heat treatment of some of the patented types of joint, or at less cost by similar treatment of a special angle bar. The joint with this bar showed a strength, at the elastic limit, equal to the rail, and would cost less than the then standard angle bar, which had a strength about 33% that of the rail. The new bar was to be used with heat-treated bolts, as, being shorter than the standard bar, it might require greater bolt strength.

Comparison of joints having four and six bolts indicated that the two additional bolts gave no increase in strength in transverse loading. It was concluded that a four-hole splice is sufficient for 100-lb. rail if it is of proper section and material. It has fewer parts and greater cross-sectional area for the same weight. As to bars 26½ in. and 18½ in. long, tests with 20-in. and 26-in. spacing of supports indicated no loss of efficiency in the joint having the shorter bars.

Switching Cars Into Station Order at Large Freight Yards

METHODS of sorting cars or switching them into station order for outbound trains are discussed briefly in the report presented by the committee on yards and terminals at the annual meeting of the American Railway Engineering Association. Suggestion has been made for the provision of a small gravity yard for this purpose, located between the classification and departure yards, but the committee finds that such an arrangement is rarely provided or, at least, rarely included in yard construction. In some gravity classification yards, such sorting is accomplished by means of a yard tributary to the hump, having its ladder next to the outside track of the main yard and its short body tracks diagonal to this. The same purpose might be effected by intermediate ladder tracks subdividing a few of the main classification tracks at one side of the yard.

In the opinion of the committee, secondary sorting of cars for station order or other similar grouping can be accomplished satisfactorily by supplementing the gravity switching for classification with flat switching by engines at the foot of the hump yard or in the departure yard. This would save the additional investment and increased length of terminal involved by an auxiliary sorting yard, and it would avoid the delay attending the delivery and removal of cars at such a yard.

In certain situations, however, the auxiliary yard may be necessary, as where it is impossible to provide a sufficient number of tracks in the classification yard, or where the number of cars to be handled is too great to permit of switching them at the outgoing end of the classification yard or in the departure yard without hampering the flow of traffic. It should have assisting grades if practicable, and the length of its tracks would be governed by the requirements of each case.

Railroad Engineers' Conference Adopts Wage Scale

Representatives of Fifty Roads Meet—Chief Discussion on Pay of Chief Engineer, Division Engineer and Tapeman

(Editorial Correspondence)

FOR the first time in the history of engineering a body of 350 engineers, representing fifty railroads, met in Chicago Mar. 17 to discuss openly and above board a minimum salary schedule for every technical position from chief engineer to tapeman. No unusual demonstration preceded this history-making meeting, only the usual setting of a well planned, well carried out convention of engineers who always take their society gatherings seriously. Born of experience gained by years of handling the intricate problems on the greatest transportation systems of the world, the men proceeded to business with reference to their own economic welfare in somewhat the same manner as has been the custom in getting practice and procedure ironed out in the American Railway Engineering Association. In railroad parlance, it might be said that the schedule was adopted as "recommended practice," but was not ready to be "incorporated in the 'Manual.'"

The program, carried out by the American Association of Engineers, was well planned. The chairman was one who all felt had given justice to young as well as old engineers. Willard Beahan is a white-haired engineer, revered by hundreds whom he has fathered into real usefulness from the time of his experiences with General Dodge, finding the line for the Union Pacific (fighting Indians meanwhile), down to his present capacity of assistant chief engineer with the New York Central.

Leading up to the main business of the meeting, which was the discussion of a "preliminary report by a subcommittee of the railroad committee," of the American Association of Engineers, was a paper on overtime by H. P. Gillette, editor of *Engineering and Contracting*, which laid down a rough rule that when the salary reached $200 a month, or when the duties became advisory, overtime allowance was not desirable. A sufficient number participated in the discussion to break the ice of acquaintance. A venerable Seaboard Air Line engineer came to mental grips with a young division engineer from the Southern Pacific. A middle-aged chief draftsman from the Missouri Pacific let the audience know that the Middle West had similar difficulties.

Discussion of Schedule

Well acquainted now, the engineers were plunged into the intricate problem of classification and salary-fixing by J. L. Jacobs, a specialist on system and organization. With his word for it that a world of work lay ahead of them in gathering statistics, standardizing positions and nomenclature, the conference was in a proper frame of mind to appraise the work of the subcommittee, a work which the Wage Board in Washington gave up in despair. W. C. Bolin, chairman, explained that the subcommittee had been at work night and day for two weeks on the problem after the paid staff of the committee had gathered a mass of information from all over the country as to existing schedules, in and out of the profession. Three elements of the schedule—the salaries of chief engineer, division engineer and tapeman—were attacked first, for, said Mr.

Bolin, with these points fixed the determination of the intermediate salaries became a matter of mathematics tempered by good judgment. Reasons for every piont were forthcoming immediately from Mr. Bolin. No question seemed to have been without consideration, and so well had he and his co-workers hit the consensus of opinion that only six salaries proposed, out of 36, were revised. A surprising unanimity of opinion was found as to nomenclature and definition. Only one position, that of assistant electrical engineer, was added, and only one name changed, that of detailer to junior draftsman.

With the schedule adopted, the conference was not ended, for still, holding to engineering procedure, the next step was a set of specifications for the plans, a paper by W. W. K. Sparrow, corporate chief engineer of the Chicago, Milwaukee & St. Paul, on "How Shall Proper Recognition Be Obtained?" Walking still on crutches from a recent accident, dramatically he called on engineers inside and outside of railway service to unite for proper concerted action all engineering societies of the country into a United Engineering Society of America. But Mr. Sparrow is not an impractical dreamer, and, until the constitution of a league of societies has been drawn—which, he well said, should not be so hard to frame as that for a league of nations—he proposed to support the organization which had fathered the conference and to urge every engineer of his acquaintance to do likewise. And when, in answering the question of a skeptic as to what he would do should the railroads refuse to consider the schedule proposed, he said, "I would not strike," the spontaneity of the applause said louder than words, "We are not that kind of an organization." "But," said Mr. Sparrow, "after the lessons of the war I believe men will get what, in justice, they are entitled to get." Organization for the purpose of giving the profession a single voice with authority back of it, licensing to give political and social status, and a broader education, with interest and activity in other than purely technical matters, were his suggestions for obtaining greater recognition.

The committee's next step is the presentation of the schedule to the Wage Board in Washington, for it is the opinion of many that that body will not refuse to reopen the hearings of February, 1918, to listen to the united voice of the railroads' most valuable and trusted class of employee.

Schedule of Minimum Salaries Adopted by Railroad Conference of American Association of Engineers

The duties of resident engineers involve construction work of ordinary magnitude. Where exceptional work is undertaken it is assumed that the assistant district engineer, district engineer or assistant chief engineer will take charge personally.

The duties and qualifications attached to the positions named are generally well understood. Any schedule of rates promulgated should specify that the work actually performed should govern. Thus, if a railroad calls a man an assistant engineer and he is actually performing the usual duties of a division engineer or other position, he should receive the pay of that position.

The rates for the higher positions do not apply to short lines, terminal railroads and roads of similar character, the rates in these cases to be in proportion to the duties and responsibilities assumed, based upon the schedule.

The schedule is not to operate to reduce any salaries now existing.

Expenses away from headquarters or in connection with moving headquarters are to be allowed.

No pay is to be allowed for overtime.

Civil service rules are to apply as to annual and sick leave.

The following schedule of salaries is adopted:

Chief engineer	$15,000 to $9000
Assistant chief engineer	9000 to 7200
District engineer	6000 to 4800
Assistant district engineer	5400 to 4200
Division engineer	4800 to 4200
Assistant division engineer	3600 to 3000
Resident engineer	4200 to 3000
Office engineer—field engineer	5400 to 3600
Engineer of bridges	7500 to 6000
Assistant engineer of bridges	5400 to 4800
Signal engineer	7200 to 4200
Assistant signal engineer	4800 to 3000
Building engineer	6000 to 3000
Valuation engineer	8400 to 7200
Assistant valuation engineer	6000 to 4800
Chief pilot engineer	4800 to 3600
Pilot engineer	3600 to 3000
Engineer accountant	4800 to 3000
General superintendent of motive power	15,000 to 9000
Assistant general superintendent of motive power	9000 to 7200
Mechanical engineer	7500 to 6000
Assistant mechanical engineer	4800 to 3600
Engineer of tests	7500 to 6000
Electrical engineer	8000 to 6000
Assistant electrical engineer	4800 to 3000
District electrical engineer	3600 to 2700
Shop engineer	4800 to 3600
Chief draftsman	3600 to 3000
Leading draftsman or designer*	200 to 250
Draftsman*	150 to 200
Junior draftsman*	125 to 150
Tracer*	100 to 120
Engineer inspector*	150 to 225
Instrument man*	200 to 225
Rodman*	125 to 150
Tapeman*	100 to 120

*Rates per month stated for junior positions cover the length of service in the respective positions, an increase of not less than $5 for each six months' service to be granted up to the maximum rate of the position.

Without the efforts of the American Association of Engineers, in bringing the conference together, in financing the machinery necessary to gather the data on which the schedule is based and in energizing individuals to action, the movement could not have been consummated. On that organization still remains the burden of opening the way to the Wage Board and of keeping the schedule up to date as conditions change. It may rest assured that support will be forthcoming from the railway engineers. W. W. D.

Machines Cut Water-Main Costs in Detroit

Shortage of labor and high wages have been largely counterbalanced by the Board of Water Commissioners of Detroit, Mich., by extensive use of machinery in laying water mains. Mechanical appliances are now used nearly exclusively for trench excavation, backfilling, tamping and pavement cutting, pumping and pipe handling. The savings per foot effected by machines in constructing pipe lines of smaller sizes are given as follows:

Size of Pipe	Hand	Machine	Saving
6	$0.59	$0.35	$0.24
8	0.58	0.40	0.18
12	1.11	0.49	0.62
16	1.62	0.99	0.63

Labor per foot in laying 42-in. and 48-in. pipe will average $8.70 by hand, and $3.50 by machinery; calking averages $1.32 per joint by hand, and $0.49 using pneumatic hammers; handling and lowering each pipe by hand labor averages $6.70, and $1.88 using the steam crane. Backfilling ditches on small lines costs about 9c. per lineal foot by hand and 3½c. per foot by machine.

Additional Meteorological Data Needed by Engineers

Points on Which More Data or Further Study Would Be Helpful, Including Rainfall Distribution and Intensity, Precipitation and Heavy Floods, Evaporation, Vegetation, Soil Infiltration, Temperature, Run-off

By Robert E. Horton
Consulting Hydraulic Engineer, Albany, N. Y.

EVERY experienced hydraulic engineer feels the need of additional meteorological data. First of all, there are far too few rainfall stations, and where the stations are reasonably close together group records should be studied to gain light for use where the stations are far apart. Periodic distribution of precipitation, rainfall intensities, flood flows, evaporation, the influence of vegetation, soil percolation, temperatures of the air and of the surfaces of both soil and water, and, finally, the broad general phases of run-off—all need attention. A brief review of the more important meteorological needs, grouped under 10 heads, follows:

1. More Stations—A much larger number of rainfall stations is needed throughout the country generally. In the East there is generally one station in each county, an average of about one station to every 1500 square miles. In England, Denmark, Saxony, Jamaica, Barbados, St. Kitts, Victoria and Mauritius there is an average of about one station to every 40 square miles. That is sufficient to provide good data for almost any small drainage basin, such as is commonly required for gravity water-supply systems. In New England the number of rainfall records available is about twice as great as elsewhere in the United States, owing to the fact that many good records are maintained in conjunction with water-works systems. But even in New England the number of stations is by no means adequate for satisfactory determination of the rainfall on many small drainage basins used for gravity water-supply.

2. Special Group Studies—In view of the sparsity of rainfall records, special groups of stations are needed, and studies based on existing data to determine the reliability, both of the long-term mean for any one station and the actual annual and monthly amounts indicated by single gages when applied over a varying radius of 1, 5, 10 or 15 miles from the station. Data are available at Providence, Worcester, Pawtucket, St. Louis and New Orleans, where rain gages are maintained sufficient in number to determine the general accuracy of a single record as applied to larger or smaller surrounding areas in those particular localities. Undoubtedly, with more data general relations could be established which would greatly increase the utility of rainfall records, and would also increase the degree of confidence which could be placed in such records where it becomes necessary to apply a single station to a considerable area.

3. Periodic Distribution of Rainfall—Experience shows that with identically the same rainfall distributed in different ways throughout the year, especially during the summer, quite different amounts of run-off may result. In applying rainfall data, in critical cases, it is, therefore, necessary to take into account its distribution as well as its total amount. It is desirable, therefore, that the total number of rainfall days per month at each station should be published, with the amount of rainfall. For example: A rainfall of 4 in. in August may all occur in four days, with heavy thunderstorms, or it may be distributed throughout 10 or 20 days. In the latter case, the opportunity for water loss by evaporation would be enormously increased by the long continued wetting of the ground surface, and the available supply for run-off would be steadier, but much smaller in amount than in the case of concentrated rainfall. I believe that practical methods can be readily developed by which the effect of rainfall distribution can be taken into account in estimating stream yield, if the number of rainfall days is known.

4. Intensities—As regards rain intensity, there are at present about 200 stations in the United States with recording rain gages. The details of these records, some of them running back to 1896, are published in the *Monthly Weather Review* and in the annual reports of the Chief of the United States Weather Bureau. No complete, exhaustive analyses of all these records have ever been made. Partial analyses, covering the records within considerable areas, or for a considerable number of stations, have recently been made by Meyer and published in his "Elements of Hydrology," and by the United States Housing Corporation, the results not yet having been published. So far as the results go, they indicate that rain intensity formulas of the same type, but with varying coefficients, can be applied to localities having widely different amounts of rainfall.

Room for Much Valuable Work

Practice hitherto in using rain intensity data in storm-sewer designing has been in general to work out a rain-intensity curve for each different place or problem. Usually, the data of the most intense and most critical storms are meager, and the results of such scattered individual studies are unquestionably less reliable than would be those obtained by thorough, general analyses involving a large number of stations of smaller rainfall characteristics. There is room for much valuable work in standardizing and analyzing rain-intensity data along more general lines. Not only this, but all attempts hitherto to utilize such data have been wholly empirical. There is reason to believe that at least a semirational formula of general application can be developed for rain intensities of short durations.

5. Great Storms and Floods—In connection with the broader problems of flood causation and flood discharge, studies of rain intensity in great storms covering periods of one to five days are needed. A valuable start was made in this direction by the Miami Conservancy District, the results being given in its series of technical reports, Part 5. Good work along similar lines, with much more numerous records on which to base the results, has been done by the British Rainfall Organization.

One of the most fundamental problems of flood control is the determination of the relative frequency of

occurrence of floods of different magnitudes, as fixing the maximum size and cost of works economically justified for flood control. Further data and analyses along these lines are much needed, and would be likely to afford results of broad utility and permanent value.

It may be noted in passing that so far as the studies by the Miami Conservancy District go, they seem to indicate that the law covering the relative magnitudes of storms of one to five days' duration, and having different intensities and frequencies of occurrence, is very similar in form to the general law covering the relations between frequency, intensity and duration of short storms, such as are involved in storm-sewer designing—with, however, probably, the important difference that temporary storage of considerable volumes of rain by suspension in the upper air, in ascending air currents, is the important factor contributing to high intensities for rainfall duration of less than, say, one hour, but is not of importance in relation to storms of one or more days' duration.

Incidentally, there is a gap between existing results of studies covering, on the one hand, rain intensities used in storm-sewer designing and of generally less than one hour's duration, and flood intensities of one or more days' duration. This seems to open up a profitable field for investigation—a field which would be very likely to lead to results useful in both classes of studies. Furthermore, in many flood problems and in numerous litigations involving rainfall, the only data available are daily rainfall records. Data and studies showing the relation between 24 hours' rain and the average duration and intensity for the actual portion of the day during which rain fell are much needed.

6. Evaporation—With regard to evaporation, very good records are now being kept by the Weather Bureau and other Government organizations. It appears, however, that records obtained from the ordinary evaporation pan, say 3 ft. square, are not directly applicable to broad water surfaces. There is need for experimental determination of what may be called the area factor or average ratio of evaporation loss from a standard pan of a certain size to the evaporation loss from an area of any given size larger or smaller. A start along this line has been made in the work of Prof. F. H. Bigelow, R. B. Sleight and others.

Altitude and Evaporation

The writer, in *Engineering News-Record* of Apr. 26, 1917, p. 196, has called attention to the physical factors underlying and controlling this so-called area factor. The area factor involves, however, certain climatic conditions, especially convective action, data for which are not included in meteorological reports. In view of the complexity of the subject, further studies, especially out-of-door experiments with evaporation pans of various sizes, are greatly needed.

In this connection, too, attention may be called to the need of further data and studies on the relation of altitude to evaporation. There is a prevailing popular notion that evaporation increases with elevation. This idea is undoubtedly derived from the well known fact that water boils more readily at high than at low altitudes. This, however, is only one of the elements involved. Mean temperature at the surface decreases on the average about 1° for 300 ft. elevation. The absolute humidity also decreases with elevation, in accordance with the exponential law developed by Hann. Wind velocity generally tends to increase with increased elevation. The amount of evaporation from water surfaces is mainly controlled by temperature, humidity and wind velocity, and is affected probably to a minor extent by other factors, including so-called radiation or black-bulb thermometer temperatures, facility for convection, and barometric pressure. Some of the factors tend to cause an increase, and others tend to cause a decrease in the amount of evaporation, with increasing altitudes. The natural result would be the occurrence of some particular elevation for which evaporation losses would be maximum. While this fact never seems to have been pointed out before, yet it is confirmed by the few good observations available, especially those of Charles H. Lee. The whole subject of relation of evaporation loss to elevation is worthy of further investigation and more rational discussion.

7. Vegetation—The subject of interception of rainfall by vegetation will be seen to be one of great importance, when it is considered that oftentimes, especially in light showers, 50% or more of the rain is caught upon and directly evaporated from trees or other vegetation and never reaches the ground. This subject has been experimented upon in Europe, and to a limited extent in the United States by the writer, and, I believe, also by the United States Weather Bureau. Further investigation and discussion would aid in laying a foundation for more rational estimates of stream flow and better determinations of water requirements for irrigation purposes.

8. Infiltration—Floods are mainly the results of direct surface run-off from heavy rains or melting snows. The direct evaporation loss during flood rains is usually only a very small proportion of the available supply of water. The difference in flood-discharging capacities of different drainage areas is, without doubt, more largely due to differences in the amount of water which can percolate into the soil during heavy rains than to any other one factor excepting rainfall itself.

Soil Infiltration During Rains

Furthermore, infiltration of rainfall is the source of ground-water supply to streams, wells and artesian horizons; yet, with the exception of some meager experiments by O'Meara and the writer, practically nothing has been done in this country relative to the determination of the amount of infiltration into different soils, on different slopes and with different rates of rainfall. Numerous formulas for estimating maximum flood discharges have been evolved, but it does not seem possible to arrive at either a rational understanding of the causation of floods or the most reliable method of estimating probable maximum flood discharge without taking into account the amount of infiltration occurring during rains.

9. Temperature—The most important factor affecting evaporation losses of all kinds is temperature. It is also an important factor in relation to floods as affecting the rate of melting of accumulated snow. Data for air temperature are generally available, but what is needed in relation to evaporation is the temperature of the soil and of water surfaces. Data on these subjects are meager. The obtaining and publishing of additional data of soil-surface and water-surface temperatures, and especially the correlation of such temperatures with air temperature, are matters which will become of increasing importance and value as the

development and use of more rational methods of handling hydrologic problems progress.

10. Run-off—The run-off or yield of a drainage basin is the difference between the precipitation on the drainage basin and the water losses due to evaporation of various kinds. The amount of evaporation from the soil surface is dependent upon the same factors which control evaporation from water surface and, in addition, it is dependent on the degree of saturation of the soil surface. Some experimental data in relation to the evaporation loss from soil surface with different degrees of saturation have been obtained by Samuel Fortier (see *Engineering Record* of Apr. 15, 1905, p. 430).

Additional experimental data along this line would be of the utmost practical and economic value, not only in relation to the ordinary problems of hydrology in estimating stream flow, but also in relation to irrigation, land drainage and agricultural engineering in general. The writer has designated the ratio of the actual evaporation rate from a soil surface at any given time and with any degree of saturation to the evaporation rate from water or a saturated soil surface as the "evaporation opportunity."

It so happens that in long periods of drought, when the evaporation rate from a saturated surface is highest, the evaporation opportunity from the soil surface decreases. It is a natural result of these opposing influences that there is some particular amount and distribution of rainfall in any locality for which the total evaporation loss from the soil is a maximum. Although this is important, the writer does not think that it has ever hitherto been pointed out. Strangely enough, it follows as a simple mathematical deduction from a number of existing formulas for calculating run-off and, furthermore, it is abundantly confirmed by experience, inasmuch as it will be found that if almost any long-term record of rainfall and stream flow is analyzed, and the results are plotted in terms of water losses against precipitation, the resulting water losses will have a maximum for an annual rainfall which generally lies between 45 and 75 in. in England and the Eastern United States.

This calls attention to the fact that the older ideas and methods of expressing run-off as a percentage of rainfall are essentially fallacious, and if engineers are to justify public confidence with regard to their ability to predict safely the available yield of water-supplies, their work must, in the future, be founded upon the use of meteorologic data now often ignored and upon more rational and detailed methods of analyzing and utilizing such data.

Licensing Laws in Oregon and Idaho—Proposed Ohio Bill

Unique Features in Ohio and Idaho Bills—Oregon Law Follows Joint Committee—Iowa's Proposed Law

PROGRESS in the movement to license engineers is seen in the fact that the Association of Ohio Technical Societies has prepared for introduction into the legislature of Ohio a bill which contains many unique features. It is designed to include all classes of professional engineers and architects; also land surveyors, by specific provision. The special features of this bill are here presented, and a short statement follows giving the features in which the bill passed by the Oregon legislature Feb. 26, 1919, differs from the Joint Committee bill, as discussed in *Engineering News-Record* of Feb. 27, 1919, p. 423. A similar bill has just been introduced into the Iowa legislature. The Idaho legislature has just passed a licensing bill, the main features of which are here given.

The Ohio bill provides for a state board to be appointed by the Governor "by and with the consent of the Senate," for the purpose of registration for professional engineers and architects. It is to consist of nine members, not more than five of the same political party, and with one representative each for civil, mining, mechanical, electrical, and chemical engineering, and architecture. The qualifications for membership include a five-year previous residence and 10 years of active practice; the latter may be in teaching the profession, but not more than three members may be appointed who have had such active practice in teaching professional engineering in a reputable college or university. The secretary of the board may or may not be a member, but must have the qualifications of a member, receives a salary to be fixed by the board, and must give a bond. Members of the board receive no compensation except necessary expenses. The board shall meet in Columbus on the last Wednesday of June each year and at other appointed times. Seven members constitute a quorum.

The bill provides that after one year from its passage it shall be unlawful "for any person to practice professional engineering or architecture, as defined in this act, or to hold public office or employment involving the practice of such professions, or to set or disturb boundary monuments in Ohio, unless such person shall have first obtained a certificate entitling him to practice professional engineering or architecture from the board. Such certificate shall state whether the holder thereof is registered as a professional engineer or architect."

Special provisions are made for registering surveyors. No map or plat of any land or mine shall be accepted unless certified by a registered professional engineer or a registered surveyor. The act shall not apply to officers holding office or officers-elect at the time of passage of the act, during the term for which they have been elected, or to engineers or architects in the employ of the United States Government, but the latter shall not do any engineering or architectural work in Ohio except that pertaining to their official position, unless they comply with the act. Registered professional engineers or architects only can qualify to give testimony as engineering or architectural experts.

Definition of Professional Engineering and Architecture—These are defined to include all branches other than military engineering, as follows: "Any person who designs *or makes drawings for* any building, bridge, railroad, harbor, water-works . . . " etc., including a complete list of possible activities for all classes of engineers, not even excepting marine architecture and landscape engineering. It includes a person acting "as resident engineer, department engineer, division engineer, assistant engineer, clerk of works, or other similar title, with authority to exercise discretion, assume responsibility, devise methods, or to perform duties ordinarily delegated to such position . . . "even though employed by or under the di-

rection of a registered professional engineer or architect. However, nothing in the act is to be construed to prevent the employment of assistants of grades below those specified "provided they are under, and report directly to, registered professional engineers or architects or a registered surveyor, who assumes all responsibility for their work." Residents outside of Ohio may be called to testify as witnesses without holding certificates.

Qualifications for Certificates—A certificate may be issued to any applicant holding lawfully a diploma in any branch of engineering or architecture, except surveying, from a college or university approved by the board, together with evidence that he has had at least two years' practical experience; or to any member in good standing in the six great national engineering societies (including the Chemical Engineers and Architects) or other national engineering organizations having similar requirements for membership; or who, within one year, submits evidence of five consecutive years' prior practice; or to any applicant who successfully passes an examination before the board, to determine his fitness for such practice. The board may grant a certificate to practice land or mine surveying to any person otherwise eligible under the foregoing requirements, whose practice has been limited to such branch, or who, upon examination, satisfies the board of his fitness to practice the same; but the holder shall not be entitled to practice any other branches except surveying and platting of land or mines.

In providing for nonresident engineers, architects or surveyors, certificates are granted to those from such states as have equal qualifications, provided equal rights are accorded by such states to Ohio registered engineers, architects or surveyors. The fee is the same as that in the state from which the engineer comes; or if there be no such fee, it is made $10.

The board may reject an applicant guilty of fraudulent methods of practice, or revoke a certificate for the same cause. An affirmative vote of not less than six members shall be required to authorize the issue or revocation of a certificate. The fee for consideration of an application is $10, without examination, and for examination the fee shall be $25; for certified copies of certificates, $1 per copy. In no case shall the fee be returned in event of refusal to grant a certificate, but unsuccessful candidates may be examined at any subsequent session within one year. Fraud in obtaining a certificate is made a misdemeanor, punished by a fine not exceeding $1000 nor less than $100, or imprisonment of not more than one year nor less than 30 days, or both. Violation is classed as a misdemeanor, punishable by a fine of not less than $20 nor more than $500, or imprisonment of not less than 30 days nor more than one year, or both. The secretary of the board is charged with the duty of enforcing the act.

Bill Passed by Oregon

The bill just passed by the Oregon legislature is almost exactly like that of the Joint Committee proposed in 1915, but with modifications stated below. It takes effect on July 1, 1919, when the term of office of the Board of Examiners also begins. It prescribes Jan. 1, 1920, as the date after which certificates must be obtained to allow practice.

The prohibition against permission to testify is omitted; the salary of the secretary of the board is specified at $1200 per annum; his bond is to be fixed by the board; the fees are to be paid into a special fund, the "Engineers' Registration Fund"; the fee for admission to examination is $10, the additional fee for certificate is $5; and $15 is required for a certificate without examination for which six years, instead of ten years, of practice are required, not necessarily immediately preceding the date of application; penalties for violation are provided by a fine of from $25 to $500, or imprisonment not to exceed six months.

The act does not apply to "any architect practicing architecture," and the time limit for engineers from without the state is placed at three months before application for examination must be made, and the following clause is added, "The service of professional engineers in the United States military service shall be considered as the practice of professional engineering, and provided further that such Army engineers may be registered without examination . . . within a period of one year from the date of their discharge." No provision is made by appropriation of money for the use of the board, although the original form of the bill proposed the sum of $3000.

Proposed Iowa Bill

The Iowa bill is also largely a copy of the Joint Committee bill, but provides for separate certificates to land surveyors. The board of examiners is composed of five, instead of nine, members, no two of whom shall be from the same branch of the profession; their compensation is at the rate of $10 per day. Each year in a recognized engineering school, if successfully completed, is allowed as equivalent to engineering practice in the six-year requirement. The fee for examination is $15, and for certificate $10 additional. For six months after the passage of the bill, certificates may be issued for $25 fee, to professional engineers or land surveyors of two years' practice immediately preceding the date of passage. Violation is a misdemeanor punishable by fine of $100 to $500, or by imprisonment for three months, or both.

Application of this act does not include full-time employees of corporations unless the latter offer their services to the public as professional engineers or land surveyors; if so, all principal designing or constructing engineers must register. Assistants to registered engineers or land surveyors are also exempt.

Idaho Legislature Passes Licensing Bill

The Idaho legislature, which recently adjourned, passed a bill providing for the licensing of civil engineers. Civil engineering is defined as "the practice of any branch of the profession of engineering other than mining, metallurgical and military."

The department of law enforcement of the state Government is empowered to conduct examinations, to pass upon the fitness of applicants for reciprocal registration from other states, to prescribe rules for holding examinations, to determine what shall constitute a school, college or department of a university for civil engineers and the reputability and good standing of such schools (the requirements of the University of Idaho for the degree of civil engineering are adopted as the standard), and to conduct hearing on proceedings to revoke certificates.

Seven persons, each a registered civil engineer of

recognized standing and having had ten years' active practice, and a resident of the state for at least one year, are to be appointed to hold the examinations. Appointments are to be made after giving due consideration to recommendations by members of the civil engineering profession and organizations. The members of this board are to receive per diem allowance of $5 and mileage.

The fee for residents of the state is to be $10 and for applicants from outside $25. Applicants shall be of good character, more than 21 years of age, have been in active civil engineering work as assistant or otherwise for at least six years, or shall be graduates of a recognized school. To any person having these qualifications and having been actively engaged in the practice of the profession for one year will be granted a certificate on payment of the fee and taking of an oath, without having to pass an examination. A person registered in any other state having a minimum requirement not less than that f idaho may be registered without examination, in the discretion of the department. Certificates may be revoked for any of the following grounds: 1, Fraud or deception in procuring certificate of registration; 2, fraud or deception in practice, or 3, conviction of a felony.

The act does not apply to engineers in the employ of the United States Government; nor to engineers employed as assistants to registered engineers, nor to nonresident engineers coming into the state for consultation, to collect information or to give expert testimony in court.

Tests Determine Effect of Air in Centrifugal Pump

By A. P. Blackstead

Camden Iron Works, Camden, N. J.

SOME time ago the writer conducted a series of tests in order to determine the effect of air let in on the suction side of a centrifugal pump.

The pump had 5-in. suction and discharge nozzles and was direct-connected to a constant-speed electric motor. The power input was measured with standard, calibrated instruments. The water pumped was weighed on standard scales, the suction and discharge heads being measured by mercury columns. A small gas meter, with inlet open to the atmosphere and outlet connected to the suction pipe, was used to determine the amount of air let in. The valve in this line controlled the amount of air. By throttling the gate valve in the main suction line a constant vacuum of 20-in. mercury was obtained simply by regulating the discharge gates where a constant total head of 60 ft. was obtained.

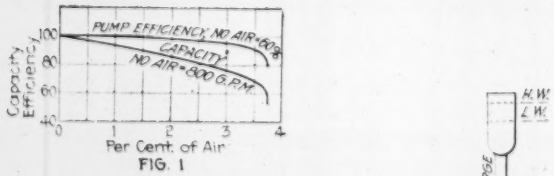


FIG. 1

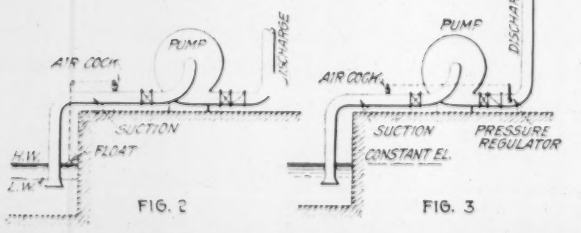


FIG. 2 FIG. 3

ARRANGEMENT TO MEASURE EFFECT OF AIR ON PUMP

The test was repeated several times, each time giving substantially the same results, which are graphically shown on Fig. 1. It will be noted that whereas the capacity took a decided drop with the increased percentage of air, the pump efficiency remained virtually constant up to a point where the pump would not handle any more air, 3.75% volumetric, where it dropped the suction. A very small amount of air, 3.12%, reduced the capacity 25 per cent.

This offers an easy method of regulating the capacity of a centrifugal pump which is working under suction. Fig. 2 shows a schematic arrangement for such a control where it is desirable to regulate the pumpage by the fluctuation of the water in a suction well, as is often the case in sewage installations. If, on the other hand, as in water-works service often is the case, the pump capacity is to be regulated by the elevation of the water in the standpipe, a similar arrangement can be made with the air cock controlled by the variation in the water pressure. This is indicated in the illustration, Fig. 3. This control will eliminate a number of objectionable features in connection with the usual automatic regulation of starting and stopping or change of speed.

It will be noted that the cost of this outfit would be very small. The control would work equally well on large and small pumps and could be applied to existing pumps without difficulty.

Winter Concreting on Miami Conservancy Work

CONCRETING has been carried on through the winter in the dam-construction work of the Miami Conservancy District, Ohio, with only occasional interruptions. As the nature of the enterprise demands that progress be rapid and according to schedule, and as it is important to keep the working organization intact, to avoid losses and delays, it became necessary to plan reducing the interruptions of concreting to a minimum.

Study of the extra costs involved in heating materials and protecting deposited concrete led to the conclusion that the greater part of the extra cost is incurred only at temperatures below 20 deg., and a general rule was therefore made that work through the cold season is to be continued until the thermometer drops below 20 degrees.

Provision for heating aggregates by steam coils built in the bins has been made at all three of the dams where concreting has been going on, Englewood, Germantown and Lockington. Means have also been provided for protecting the surfaces from freezing by tarpaulins and salamanders, or, in some instances, by steam coils (where steam was available because it was used for other purposes).

Care is taken that no fresh concrete is placed on frozen foundations. With a view to reducing the liability of freezing also, the amount of water used in mixing is closely regulated.

At two of the dams most of the concreting has been in footing trenches, and, as this situation protects the concrete from wind, protection from freezing is relatively simple. At Lockington, however, the concrete walls under construction project high above ground and are more difficult to protect; work at Lockington has therefore been held up in cold weather during a greater part of the time than at the other dams

Effect of Cold-Working and Rest on Endurance of Steel

Cold Pressing and Rolling Have Slight Effect on Results of Reverse Stress Tests—No Gain from Rest Periods

ALTERNATE-STRESS tests were applied to the investigation of a new question by Prof. H. F. Moore and W. J. Putnam of the University of Illinois, during the past year. Their results were reported to the American Institute of Mining Engineers last month in a paper entitled "Effect of Cold-Working and Rest on the Resistance of Steel to Fatigue under Reversed Stress." Briefly, they sought to determine whether the improvement in strength and elastic limit of a piece of steel by cold-working, such as rolling, stretching or compressing, is accompanied by improvement in the endurance of the steel under reversal of stress many times repeated. Furthermore, since it is known that the effects of overstrain are diminished by a period of rest (as well as by low heating, such as through immersion in boiling water), it was desired to find whether rest benefits the fatigue strength. Essentially, the results of the many series of tests made to answer these two questions were negative. That is, cold-working does not increase the fatigue strength, although it also does not distinctly decrease it; and no marked benefit through rest could be detected.

Underlying the experiments was the thought that the service of steel is in the last analysis determined by its resistance to repeated stress—in other words, its endurance—and only in less degree by its static qualities, such as tensile strength and elastic limits. If, therefore, the marked raising of elastic limit in steel through cold-working is paralleled by a raising of the fatigue strength, very important practical conclusions would follow.

For some years Professor Moore has studied fatigue tests on the hypothesis of the exponential law as a satisfactory working formula. According to this law, the number of repetitions of stress which a given material will stand is in inverse proportion to some power of the unit stress applied. The hypothesis is convenient because the curve connecting unit stress and number of repetitions becomes a straight line when plotted on logarithmic paper, which greatly facilitates the comparison of experiments made in widely different ranges, though it does not remove the possibility of committing serious error in such extensions from one range to another. Experiments have given a fair degree of support to the exponential hypothesis. It is on the safe side because it calls for a low working stress for very great numbers of repetition.

In the series of tests summarized in the three diagrams of Fig. 1 the Upton-Lewis vibratory testing machine was used. This works on a flat specimen, in this case a strip having a reduced section about $\frac{3}{8}$ in. wide and about $2\frac{1}{2}$ in. long, and gives complete reversals of bending stress at the rate of 250 per minute. Other tests, one series of which is summarized in Fig. 2, were made on the White-Souther machine, which uses a cylindrical specimen, in this case $\frac{1}{2}$ in. in diameter and $4\frac{1}{2}$ in. long from edge of support to center of bearing of load

In Fig. 1 the points representing the individual tests are not marked, but Professor Moore has stated that

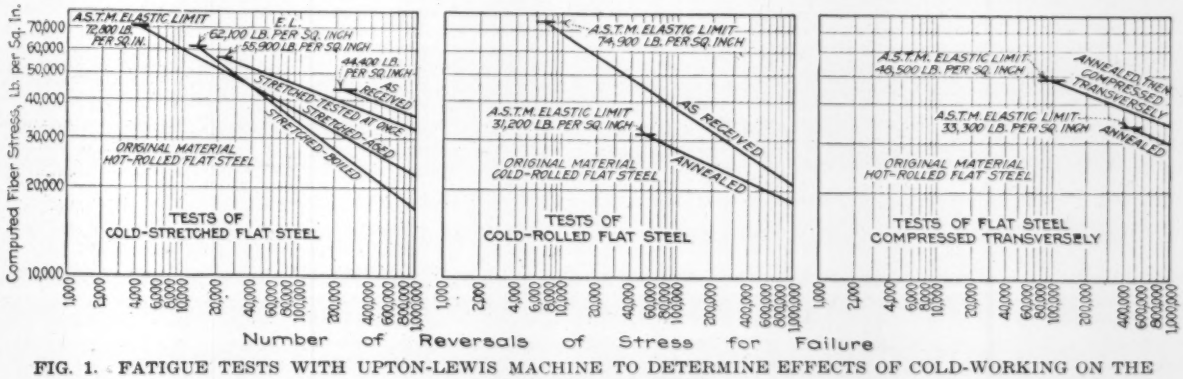

Computed Fiber Stress, Lb. per Sq. In.
A.S.T.M. ELASTIC LIMIT
70,800 LB. PER SQ. IN.
E. L.
62,100 LB. PER SQ. INCH
55,900 LB. PER SQ. INCH
44,400 LB. PER SQ. INCH
AS RECEIVED
STRETCHED-TESTED AT ONCE
STRETCHED-AGED
STRETCHED-BOILED
ORIGINAL MATERIAL HOT-ROLLED FLAT STEEL
TESTS OF COLD-STRETCHED FLAT STEEL
A.S.T.M. ELASTIC LIMIT 74,900 LB. PER SQ. INCH
AS RECEIVED
A.S.T.M. ELASTIC LIMIT 31,200 LB. PER SQ. INCH
ANNEALED
ORIGINAL MATERIAL COLD-ROLLED FLAT STEEL
TESTS OF COLD-ROLLED FLAT STEEL
A.S.T.M. ELASTIC LIMIT 46,500 LB. PER SQ. INCH
ANNEALED, THEN COMPRESSED TRANSVERSELY
A.S.T.M. ELASTIC LIMIT 33,300 LB. PER SQ. INCH
ANNEALED
ORIGINAL MATERIAL HOT-ROLLED FLAT STEEL
TESTS OF FLAT STEEL COMPRESSED TRANSVERSELY
Number of Reversals of Stress for Failure

FIG. 1. FATIGUE TESTS WITH UPTON-LEWIS MACHINE TO DETERMINE EFFECTS OF COLD-WORKING ON THE ENDURANCE OF STEEL

they are not much more scattering or distant from the lines drawn than the tests shown in Fig. 2. However, many of the tests were to the left of the section of curve drawn; that is, they were above the static elastic limit (as determined under the American Society for Testing Materials' specification, by the sudden increase of rate of stretch of a tension specimen as shown by the extensometer).

Briefly, the comparative endurance of two specimens represented by two different lines on the diagram is to be estimated by the position of the lines above or below each other; the upper line indicates material of greater

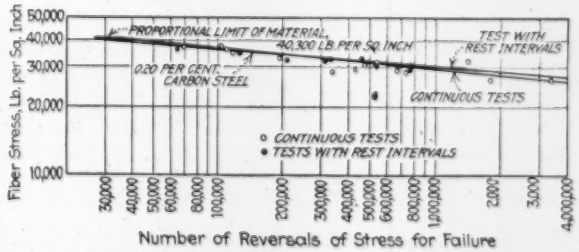

Fiber Stress, Lb. per Sq. Inch
PROPORTIONAL LIMIT OF MATERIAL, 40,300 LB. PER SQ. INCH
TEST WITH REST INTERVALS
0.20 PER CENT. CARBON STEEL
CONTINUOUS TESTS
o CONTINUOUS TESTS
• TESTS WITH REST INTERVALS
Number of Reversals of Stress for Failure

FIG. 2. ALTERNATING-STRESS TESTS WITH AND WITHOUT REST INTERVALS (WHITE-SOUTHER MACHINE; STEEL 0.20% CARBON)

endurance. Judged by this criterion, it will be seen that in the first diagram of Fig. 1 the (hot-rolled) material was of better endurance in its original condition than after cold-working by stretching, or after 60-day aging or 15-minute boiling treatment subsequent to the stretching. In the second diagram of the same figure cold-rolled material showed better endurance in its original condition than after annealing, which effect is the opposite of that indicated by the preceding diagram. The explanation may be that cold-rolling involves a compressive action and for that reason strengthens the material in endurance, while the cold-stretching in the previous diagram weakened the material. The same indication may be gathered from the third diagram of Fig. 1, in which hot-rolled material strained by transverse squeezing showed slightly better endurance than the same material not compressed. In any event, however, the effect of the cold-working on endurance is not great, and the practical conclusion is that cold-working does not have any marked effect on the endurance of the metal, although it modifies very profoundly the elastic limit and other static tensile properties.

Various series of tests to investigate the effect of rest after cold-working are fairly typified by the diagram reproduced as Fig. 2. It is to be concluded from this that the rest intervals (either one or two, of 24 hours each) did not improve or otherwise change the endurance qualities of the material.

In view of the fact that failure in endurance tests has been shown to be due to the slow opening up of separations between the grains of the metal, starting probably from some slight local defect, it is not an unexpected result that rest has no effect in restoring the damage done by the previous repetitions of stress. The starting and gradual growth of this detailed failure in alternating-stress tests has been shown most strikingly by Professor Moore through moving-picture microphotographs that were taken of a small polished and etched spot on the side surface of one of the endurance specimens.

Sanitary Service Rids Construction Camp of Influenza

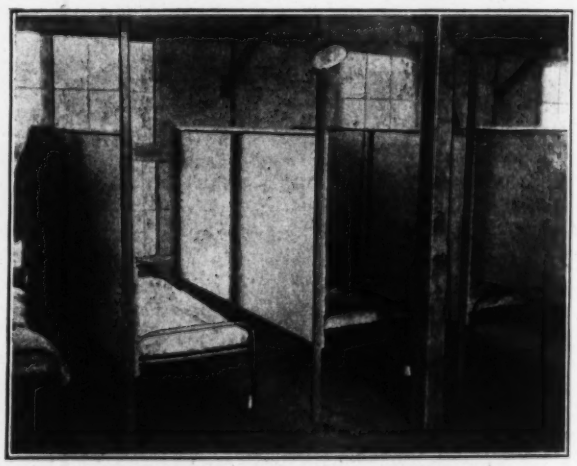
Strict Enforcement of Ordinary Sanitary Precautions Kept Intact Working Force on Camp Custer Extension When Surrounding Communities Were Decimated by Disease

By M. D. Kauffman
Division Engineer in charge of Sanitation, Camp Custer Extension

DURING the height of the influenza epidemic last autumn the construction force building the extension to Camp Custer suffered no diminution on account of disease. Instead, the superior reputation for healthfulness of the camp led to an increase of 50% in the applications for work. Construction progress was maintained at scheduled speed while on neighboring jobs work lagged because of workmen lost through disease and desertion, and communities all about had closed theaters, schools and churches and were conducting all business under quarantine restrictions. Specifically, from Oct. 6, when the working force was 1281, to Nov. 15, when it was 2572 men, there were four cases of influenza and one case of pneumonia, and altogether only 14 cases of sickness demanding the attention of a physician. By this time 65% of the work was completed. From Nov. 15 to Dec. 31, when the working force fell from 2572 to 1080 men and 95% of the work had been finished, only 10 more cases of sickness occurred. Thorough sanitary service explains these facts.

Success in sanitary service at Camp Custer came from attention to detail. No unusual hygienic or sanitary measure was employed; also, no essential hygienic precaution was neglected, and no carelessness in its execution was permitted which vigilant inspection could prevent. The story to be narrated is, therefore, a story of details and not one of general practices.

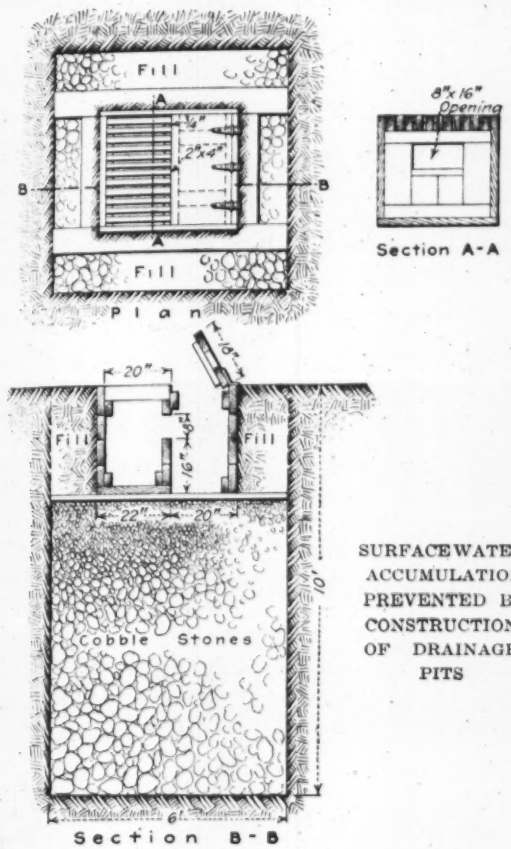
Camp hygiene began with personal cleanliness, and no other single provision counted so high toward the sum of the results obtained. Ample and comfortable facilities for body bathing and for washing clothing were provided. Every workman was required to bathe thoroughly once a week. Men having the handling of food in any way had to bathe twice a week, to brush their teeth daily and to wash their hands frequently. Discharge followed refusal to comply with rules for bathing or refusal to change frequently to clean clothing. Lavatory attendants and bunk-house caretakers kept careful watch to detect lack of cleanliness. If carelessness was observed the man was reported and subjected to such examination as seemed required. If communicable disease was discovered, the workman was isolated and his personal effects were disinfected, or



WALLBOARD SCREENS BETWEEN COTS CONFINED SPRAY FROM SNEEZING

he was handed over to a physician or to the hospital, as the circumstances required. If body vermin were discovered the man was isolated until the trouble was eradicated. Refusal by the workman to submit to these requirements was met by discharge from the camp. All but a very few of the men coöperated cheerfully in maintaining the high standards of personal hygiene.

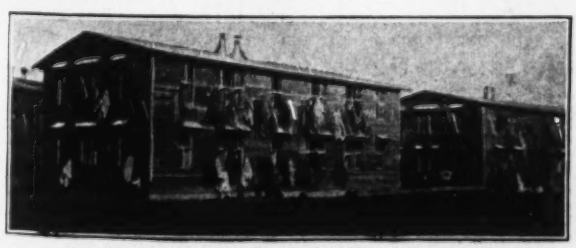
Bunkhouses accommodated 65 men, and at the height



SURFACE WATER ACCUMULATION PREVENTED BY CONSTRUCTION OF DRAINAGE PITS

of progress 20 of them were occupied by an average of 1200 men. All were furnished with iron cots and straw ticks; cots were set 20 in. apart and were cubicled off by semipartitions of wallboard arranged as illustrated. These partitions reduced the danger of infection from spray from coughing and sneezing and did not interfere with ventilation.

Each bunkhouse had a day caretaker and a night caretaker. After the workmen left the bunkhouse in the morning the day caretaker opened every window full top and bottom and kept it open four hours. All blankets were removed from the beds and hung outside for a period of six hours daily when the weather permitted. Every Monday, cots and ticks were put outside and sunned and aired for four hours. Cots, floors and wall surfaces were sprayed daily with 5% lysol solution. Floors were swept morning and afternoon and scrubbed at least twice a week. Before each sweeping the floor was sprinkled with sawdust saturated with a solution of 5% lysol, 5% formaldehyde and 90% water. A half hour after sweeping all flat surfaces were wiped with a damp cloth or oil duster. All woodwork, including the floors, partition supports, etc., was scrubbed once a week with soap and water, and windows were cleaned and polished once a week.



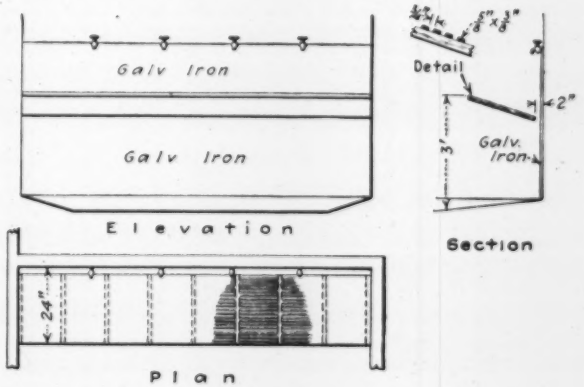
BLANKETS SUNNED AND AIRED FOUR HOURS EVERY DAY

Spitting, except into cuspidors, was prohibited within or adjoining bunkhouses. Six cuspidors were provided for each floor. All were emptied daily and the contents were removed to the dump and buried. The cuspidors were then scrubbed inside and outside with soap and water and refilled with clean sand sprinkled over the top with chlorinated lime.

The spread of vermin was prevented by examination of the clothing of men applying for accommodations; by daily inspection of walls, cots and bedding; by spraying walls, cots and ticks monthly with a solution of two drams of chloride mercuric and 16 oz. of wood alcohol; by prohibiting the keeping of food or of cast-off clothing in the bunkhouses.

Rules for ventilation at night required that eight windows, three in each side and one in each end, be kept full open from 9:30 p.m. to 4:45 a.m. Inspection was made nightly to enforce this regulation.

One attendant was assigned to each compartment containing 24 water closets, 30 ft. of urinal trough, 10 showers and 30 ft. of wash trough. The floors were scrubbed every morning, and swept and mopped every afternoon and evening. Walls, doors and woodwork were scrubbed weekly with soap and water. Cuspidors in the lavatories were emptied and scrubbed twice daily. Water closet bowls were washed with soap and water and scoured inside each day with lye. Incrustations in the bowls were removed with muriatic acid. Water-closet seats and the wood in wash troughs were washed three times a day. Urinal troughs were scrubbed and treated with kerosene or crude oil every morning and afternoon.



FREQUENT LAUNDRY TUBS ELIMINATED EXCUSES FOR DIRTY CLOTHING

Privies were used only when work had to be done before sewerage was installed. One attendant took care of three privies. Floors and troughs were scrubbed twice a day, and seats were washed with soap and hot water three times a day. Chlorinated lime was used freely in vaults and troughs and the ground under the troughs was kept soaked with crude oil. When a privy was abolished, 6 in. of air-slaked lime was spread over the contents of the vault, and it was then filled to within 6 in. of the surface. The ground for 3 ft. around the vault was then excavated to a depth of 6 in. The excavated and vault area combined were then covered with burlap soaked in crude oil. The area was then filled to the surface with cinders.

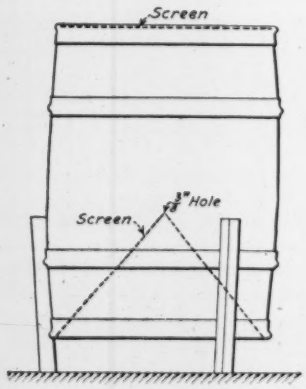
One or two collections of waste were made daily. A morning collection covered the whole camp area and included all waste; an afternoon collection covered the occupied area only and included only garbage and refuse.

Two two-horse teams, each with a driver and two men, did the collecting. Garbage was handled in 40-gal. covered cans, and 15 cans were a wagon load. For ashes and refuse the wagon bodies were divided by movable partitions into a forward compartment for refuse and a rear compartment for ashes. Ashes were used for filling depressions and for drives; refuse and garbage were taken to the dump. At the dump the garbage was burned and the cans were washed for return to the mess halls. Refuse was first sorted for materials having a salvage value, then the remaining combustible materials was burned and the incombustible material was piled. Three men at the dump assisted by the men on the wagons sorted and salvaged the refuse, buried the garbage and burned or piled the waste. A record of salvage kept for eight days, for roofing paper, lumber, cement sacks, nail kegs and tools, showed enough value recovered to meet the cost of 15 men and four teams required for street cleaning, refuse removal, dump service and the filling of the water barrels.

Manure from the stables accommodating 200 horses was handled separately. There was an attendant for each 20 stalls. Each morning and noon the stalls were cleaned and sprinkled with crude oil or quicklime. Manure was collected in piles outside the stables and removed daily to adjacent farms and spread on the land. After removal, the ground where the piles had been was sprinkled with quicklime. If delayed removal permitted fly larvæ to develop, the piles were sprinkled with a solution of 1 lb. of powdered hellebore and 25 gal. of water.

Rubbish, garbage, manure and all other forms of decomposed matter that could attract flies were protected until disposed of. Garbage platforms were scrubbed and disinfected daily. All rooms were screened and provided with fly paper. Fly traps baited with vinegar and sugar, stale meat and banana skins were placed in all locations where flies were observed to congregate.

To eliminate mosquitoes all small pools were filled, and every place in which water could accumulate was eliminated. Filled fire barrels were filmed with oil.



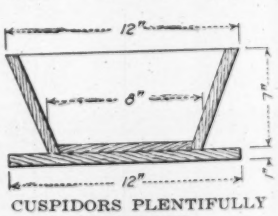
BARREL TRAPS REDUCE FLY PEST

Water supplied from Camp Custer was of established purity, and the only precaution necessary was to keep it uncontaminated. For drinking purposes, improvised bubbling fountains were located at convenient places about the work. On isolated jobs, where the installation of fountains was not warranted, paper drinking cups were issued to the men and water was carried to them in covered pails. Common drinking cups

BUBBLE FOUNTAIN IMPROVISED FROM WATER BARREL AND TIN CUP

were absolutely prohibited. As an inducement to the workmen to keep their quarters clean and orderly, as well as to provide an essential item in complete sanitary service, the streets and grounds were kept clean. A force of one foreman and four laborers was provided. The streets and roadways were cleaned daily, and the grounds were raked every morning and policed all day to remove stray accumulations. Besides doing routine cleaning, the force filled in damp hollows, dug small drains, banked around buildings, repaired walks, and did other necessary work.

Not including mess-hall sanitation, which will be described in an article to be published later, the sanitary squad during the week of Nov. 8-14, when operations were most active, comprised 80 men, of whom 23 were on night duty. During this week the average daily working force was 2421 men, and an average of 1175 men was housed daily in the bunkhouses.



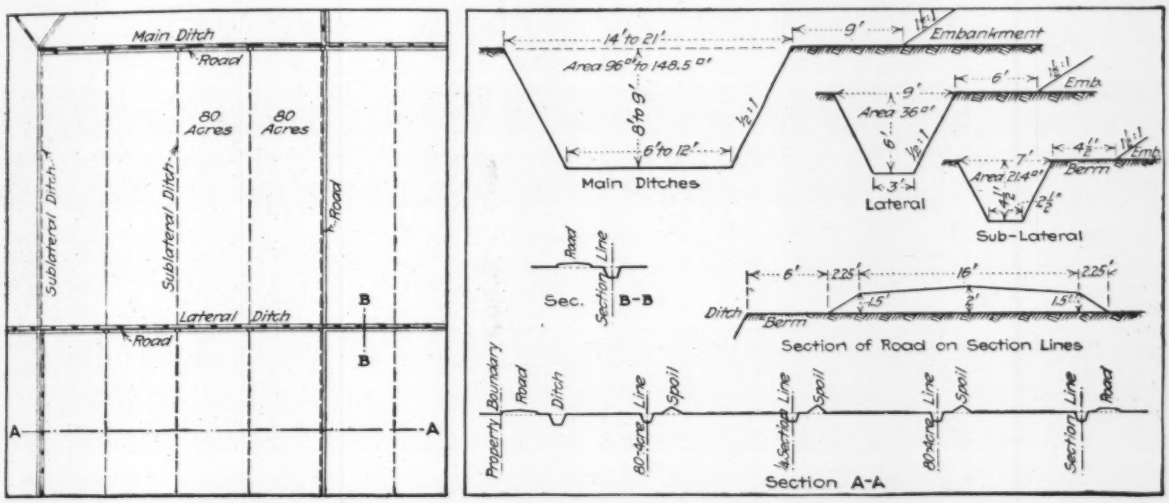
CUSPIDORS PLENTIFULLY PROVIDED

The construction of the extension to Camp Custer was under the direction of Maj. T. A. Leisen, constructing quartermaster. Samuel A. Greeley of Chicago was supervising engineer. The W. E. Wood Co., of Detroit, Mich., was general contractor. The writer, M. D. Kauffman, of Chicago, was division engineer in charge of sanitation. Valuable supervision and inspection work was also done by Lieut. G. W. Long, United States Army.

Ditch and Road Work Combined on Drainage Project

Spoil from Drag-Line and Wheel Excavators Builds Roads—Engineer Uses Tractor Plows to Break Heavy Surface Mat

TO OPEN up for settlement an area of 40,000 acres of swamp land the Virginia-Carolina Farms Co., Beaufort, N. C., is constructing a system of drainage ditches, and is utilizing the excavated material for roads along the section lines. The land lies north of Beaufort, between the Neuse River and Gore Sound, and is 12 to 16 ft. above sea-level, with a slight slope toward both waterfronts. It has about 4 ft. of wet muck over a clay stratum. The nearest railway is 12 miles distant, and a wharf will be built on the Neuse River waterfront to accommodate river craft.



DITCH AND ROAD LAYOUT PROVIDES FOR RECLAMATION OF WET LAND

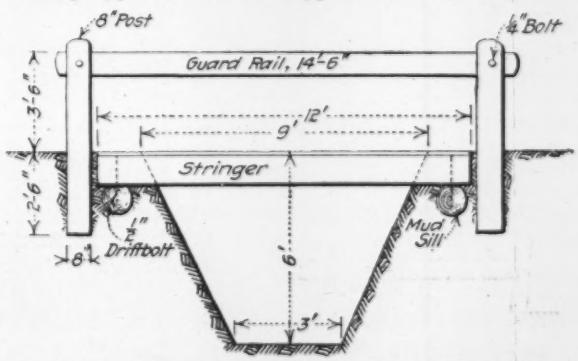
Land in that part of the country is not laid out on the ordinary rectangular section system, but is in irregular tracts described by metes and bounds. As most of the trees and other marks used as the original survey points disappeared long ago, and as the creeks whose center lines were recorded as boundaries have shifted their positions, it was no easy matter to determine the boundaries of the area to be improved. It is of irregular shape, but the topographic conditions were favorable to a rectangular subdivision, with main and lateral ditches following the section and lot lines, and roads paralleling the section-line ditches.

Shrinkage of the soil due to drainage is expected to cause an average settlement of 10% in the depth of the muck stratum, but as all the ditches are bottomed in the stiff clay substratum this settlement will not affect the drainage works. The main ditches slope in two directions, to the two waterways mentioned.

There is little timber on the drained area, but some timber land is adjacent. The surface growth is largely gallberry-fetter bushes and also bay bushes and vines, whose roots cause a dense mat about 9 in. thick. Handling this mat is a difficult problem, as it will not burn, even when the growth is cut and burned. Experiments made by the engineer indicated successful treatment by deep plowing and rolling. A 6-ton caterpillar tractor developing 3000 lb. drawbar pull hauled a plow with two 18-in. bottoms which cut through the mat and threw it in furrows. The plow would not turn the furrows so as to bury the mat, but the plowed surface was spread and leveled by running over it with the tractor in such a way as to press the former top of the mat down into the muck. The soil is so sour that it must be treated with lime and left for about a year before it can be used for crops.

Main ditches have a bottom width of 6 to 12 ft., with slopes of ½ on 1 and a depth of 8 to 9 ft. Laterals have a minimum bottom width of 3 ft., with 6 ft. depth; and sublaterals a 2½-ft. width with 4½-ft. depth. In all cases, the berm width is equal to the depth of the ditch. For the roads, the spoil bank is leveled down and topped with the clay, forming a fill of the section shown. Numerous bridges are required. These are of very simple construction, consisting of stringers drift-bolted to mudsills placed about 18 in. back from the edge of ditch and carrying two layers of 2 x 12-in. planks, 14 ft. long. Posts set in the banks carry guard rails, as shown.

Excavation was done by a dragline machine of the walking type and a wheel-type machine mounted on



CHEAP TIMBER BRIDGES CARRY HIGHWAYS OVER DRAINAGE DITCHES

caterpillars. The former had a 1-yd. bucket. The latter, with buckets on the rim of the wheel and inclined side-arms to cut the slopes, could excavate a finished ditch at the rate of 8 ft. per minute.

There was considerable trouble in obtaining and keeping a labor supply, the men available being independent and their work poor in proportion to the wages paid. The labor force averaged 80 men. Work was commenced in January, 1917. W. H. Rosecrans, Chicago, is engineer for the company, with W. H. Winsett as resident engineer. The contractors are William H. Esson and Roberts Brothers, Chicago.

Indianapolis Garbage-Reduction Profits

NET profits of nearly $15,000 are reported from the operation of the garbage-reduction works of Indianapolis from May 26 to Dec. 31, 1918. On the former date the works were taken over for $175,000 by the Board of Sanitary Commissioners of the Indianapolis Sanitary District, which has since operated the plant. During the approximately seven months of public operation 12,187 tons of garbage and related material were treated, at a total cost of $72,550 or $5.95 per ton, including capital charges. In more detail the figures were:

		Per Ton
Operating revenue:		
Grease	$63,666	$5.22
Tankage	19,502	1.60
Hides	4,259	....
Total	$87,427	
Operating expenses:		
Plant department	$36,371	$4.21
Transportation	7,090	.58
Purchase of dead animals	5,511	....
Purchase of meat and grease	1,355	....
Total	$50,327	
Capital charges:		
Depreciation	$17,500	$1.43
Interest on bonds	4,703	.38
Total	$22,203	$1.81
Total annual revenue	$87,427	....
Total operating and capital charges	72,530	....
Net income	$14,897	$1.22

Attention is called to the income of $37,100, which is the difference between the total income and the operating expense. Out of this amount the sum of $17,500 has been laid aside for depreciation. This is for a seven-month period and is at the rate of $30,000 per year. At this rate, Jay A. Craven, member and secretary of the commission says, the plant will more than pay for itself in a five-year period, as at the end of that time the plant will be in in an operating condition and worth considerable money even as scrap value. In addition to depreciation, the interest on bonds, $4703, has also been allowed for the seven-month period. After deducting these two items, Mr. Craven states, a net profit of $14,897 remains, which represents a return of 8½% on the investment of $175,000.

In addition to a favorable return on the garbage plant, says Mr. Craven, a considerable saving not shown in the figures above, is being made in the collection end. In the seven-month period during which the city did the collecting in 1918, the total cost was $29,766. This covers the summer months, when the costs are heaviest. On this basis, however, the costs for the year would be $51,000, approximately $2000 more than the old contract price with the former reduction company, and $36,900 less than the new price of $87,900, the amount of a bid received for the collection and reduction of garbage for a year.

Mr. Craven sums up by saying that by taking over garbage collection and disposal the city has saved at the rate of $37,000 a year to the taxpayers, neglecting altogether the net profit of practically $15,000 for a seven-month operation of the garbage-reduction plant.

Auxiliary Outlet Gate Relieves Main Gates of Dam

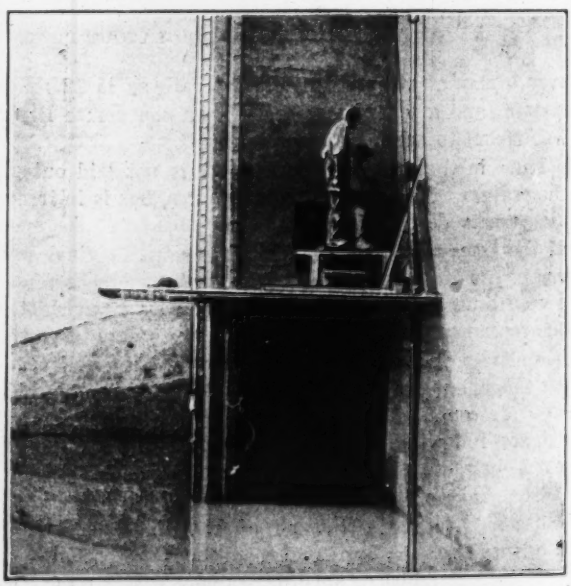
Drillers on Suspended Platform Cut Opening in Gate Well to Avoid Operating Main Gates Under High Head

BY R. C. E. WEBER,

Assistant Engineer, United States Reclamation Service, Orland, Calif.

OPERATION of the original service gates at the East Park Dam of the Orland, Calif., project of the United States Reclamation Service has always been somewhat difficult under high heads. The gates are 48 x 60 in. When operated under the full head of 65 ft. for the first time in 1911, scoring of the bronze bearings resulted. New bearings were substituted in 1911 and 1912 on both gates, which resulted in improvement in that the new bearings did not score, but still under full head the gates were operated with considerable difficulty.

To eliminate the necessity of operating them under high head it was determined to install an auxiliary gate at a higher level which would furnish sufficient discharge till the water surface in the reservoir reached an elevation that would permit of operating the lower



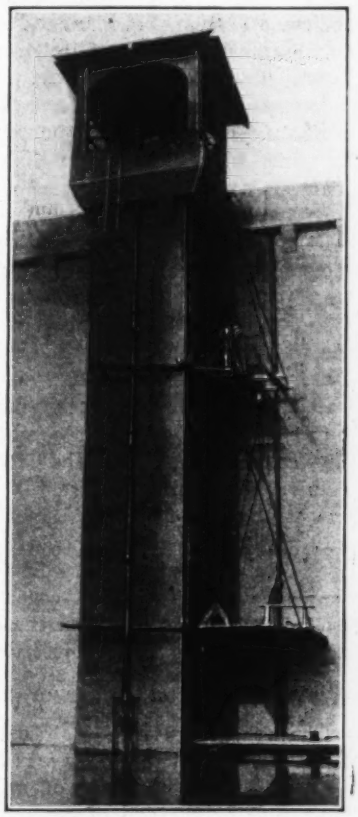
PUTTING ADDITIONAL GATE IN GATE WELL AT DAM

gates with less difficulty. Accordingly a 36 x 36-in. gate was designed, to be located in the north side of the gate well, with its sill at El. 152. Full reservoir level is at El. 188. The gate was designed by the Denver office of the United States Reclamation Service.

The work of installing the gate was commenced on Oct. 12 and completed Nov. 5, 1916, with a force con-

sisting of the writer in charge and two experienced drillers. With the exception of the help of an additional man at the time of raising the gate stem into position, this force performed all the work of installation. The water in the reservoir stood at El. 143, or 43 ft. above stream-bed level at the dam, which precluded the use of scaffolding.

A platform 8 x 12 ft. was suspended from the top of the gate well by means of wire ropes and was secured with its floor 18 in. below the sill of the new gate. The 36 x 36-in. hole through the tower wall, 21 to 24 in. thick, was driven by first drilling a 1½-in. hole and then removing the concrete with steel gads and sledge-hammers. The opening was completed in 1½ days by the two drillers. No reinforcing was encountered, the walls of the gate well being plain concrete. The 12 horizontal holes for the bolts securing the gate frame were drilled with ¾-in. drill steel fitted with a 1½-in. bit. In drilling the vertical hole through the 4-ft. tower coping, for the 2⅛-in. gate stem, a 1-in. core hole was first drilled and followed by a 4-in. drill. The smaller hole was made to avoid cleaning while working the 4-in. drill and also to serve as a guide for the latter. Numerous large stones were encountered by the larger drill and the resulting hole was irregular in section. It was rounded out by means of smaller drills and chisel-pointed steel. The rocks encountered were boulders, and very hard to drill and break.



LOWER PLATFORM IS FOR WORK AT GATE AND GATE OPENING. UPPER PLATFORM IS FOR PLACING THE GUIDES OF GATE STEM

For drilling the four horizontal holes for each of the three stem guides, a smaller platform with floor 4 x 6 ft. was swung from the top of the gate well. This platform was of such weight that it could be raised and lowered readily to the different elevations of the stem guides. The holes for the stem guide bolts were drilled after the gate frame, leaf, stem and stand had been properly adjusted.

The gate stand was taken to its position on the top of the gate well by means of the steps leading to the top of the dam. Block and tackle were used in raising and lowering it over the steps. The gate frame, stem and leaf were floated to the dam on a raft and hoisted into position by means of a 4-part line of 1¼-in. manila rope and double blocks. A lead gasket 1½ in. thick was placed between the concrete and the gate frame. This was calked after the frame was secured to the wall by anchor bolts, thus securing an even bearing for the frame as well as a watertight junction between wall and frame. All anchor bolts for the gate frame and the stem guides were grouted into place with a rich mixture of sand and cement. Holes for the anchor bolts for the gate stand were drilled after final adjustment of the stem and stand. These bolts were secured to the floor of the gate well by babbitt. The total weight of the gate complete was 3017 pounds.

Engineer Arbitrators Fix Value of Water-Company Property

Time and Money Saved by Engineers on Ground After Their Representatives Had Made An Inventory

BY FARLEY GANNETT
Consulting Engineer, Harrisburg, Penn.

ONCE more a board of engineers has satisfactorily and promptly valued a water-works plant for purchase by a municipality. On July 1, 1918, the Borough of Huntingdon, Penn., purchased the plant of the Huntingdon Water-Supply Co., after years of controversy in the courts. The purchase followed the award of a board of arbitrators consisting of five engineers. The price set by the board was $157,684.

When the plant was built in 1885 a clause was inserted in the franchise providing for the right of purchase by the borough at the end of each ten-year period, the value to be set by a board of five engineers from which there was to be no appeal. The borough had the right by the contract with the company to refuse to buy the plant after the price was set by the arbitrators, but the sale took place and the borough is now operating the property. The company, according to the terms of the contract, had to sell if the borough decided to buy at the price set by the board, and although the price was less than that for which the stockholders were previously willing to sell the property, based perhaps on the earnings, it was not so much lower as to cause a great sacrifice. The company carried the plant value in its books at approximately $220,000, and the county court had, a few years previous to the award of the arbitrators, set the value, for ratemaking, of approximately $135,000.

In 1915, one period of 10 years having elapsed, the borough started proceedings, but these were objected to by the company, and after more than two years of struggle in the courts the arbitrators were finally appointed in the summer of 1917. The board consisted of Frederick P. Stearns, Boston; John M. Rice, Pittsburgh; E. W. Hess, Clearfield, Penn.; Fred C. Dunlap, Philadelphia, and Farley Gannett, Harrisburg. A detailed inventory was made by representatives of Mr. Rice and Mr. Gannett, working in the field together, and this was presented to the board sitting in Huntingdon, when unit prices were applied after inspection of the plant and the taking of some testimony.

The plant consists of a timber intake dam and brick pumping station, a reservoir and a filter plant, with the normal pipe lines, valves, hydrants, etc., for a town of 7500 population.

Extracts from Valuation Decision

The board was in session only 10 days, and handed down its decision on Jan. 28, 1918.

The following extracts are from the report of the board:

The schedule upon which the above valuation was based includes the real estate, buildings and other improvements, water rights, dam, intake basins, old pumping station and equipment, reservoir, filter plant, tanks, piping system, services, meters, fire hydrants, tools, supplies, equipment, office furniture and new filter-plant drawings. This schedule represents the property as of Sept. 1, 1917.

The schedule does not include the electric pumping station and its equipment, which are not included in the valuation, as the evidence presented to the board of arbitrators, including the contract between said water company and the electric company, dated July 20, 1907, indicates that this pumping station and its equipment are not owned by the Huntingdon Water Supply Company.

Guided Largely by Reproduction Cost

The board of arbitrators, in its determination of the value of the different parts of the water-works, has been guided largely by the cost of reproducing such parts, using as the unit prices for property, labor and materials the normal prices of recent years and not the abnormal prices which now prevail as a result of war conditions. No records could be found from which the original cost of the various property units constructed prior to 1900 could be ascertained, but for subsequent years records were available, and these have been used in many cases either to determine the cost or to aid in determining the reproduction cost of parts of the property added during and after 1900.

After determining the cost of the various parts of the property in active use as if they were new, a deduction has been made to cover the depreciation in value of each part, the intention being to make the amount of depreciation represent as nearly as practicable the actual loss of worth of the particular part resulting from the expiration of a part of its serviceable life, including the effects of wear and physical decay.

For parts of the property not in active use and no longer serviceable for future use, the salvage or scrap value has been allowed.

In determining in the first instance the cost of reproduction of the various property units, no allowance was made for contingencies or for omissions from the schedule, or for the overhead costs of promotion, organization, financing, administration and legal and engineering services. To cover these and other similar costs, a sum has been added to the previously determined cost of the real estate and plant.

In order to cover the additional cost incidental to the necessary use of money during the period when the works were under construction up to the beginning of their regular operation, a further sum has been added for interest during construction.

The total amount determined in the manner indicated has been adopted as representing the value of the water-works as a completed property ready for operation. A property of this sort requires still further expenditure in order to develop the business to the point where an adequate return is secured. Therefore, to the above total amount, a sum has been added to represent the increased value of the property as a going concern with a developed business and established earnings.

Several interesting points came up in the appraisal and are discussed briefly below:

Real Estate—The company owned a large tract of land, on a hill behind the town and extremely well situated for a reservoir. On a small part of this tract the distributing reservoir was built. The testimony showed that to have bought only so much of this land as was needed for the reservoir would have cost almost as much as the whole tract cost. Three real-estate dealers were engaged to value the real estate for the board of arbitrators, giving their opinion of the value of the property without regard to its value for water purposes, and to this value the board added what it deemed the proper amount for this use.

Filter Plant—A filter, built in 1900, but now seldom used, was treated as nearly obsolete but having some value by reason of the sale value of the machinery and equipment. Plans had been drawn covering a new mechanical filter plant, and allowance was made in the valuation for the cost of these plans.

Pumping Station—A steam pumping station and equipment of boilers and pumps were constructed at the time when the plant was built, but for several years had not been used, as the pumping was being done by electric pumping equipment. The new station and its electrical equipment were built by an electric company from which power was purchased. This contract provided that at the end of 10 years the pump station and equipment would become the property of the water company. This station was not included in the inventory or valuation, and the old steam station was included at a considerably depreciated value.

Going Value—A separate sum was added to the physical value to cover the "increased value of the property as a going concern with a developed business and established earnings." In this case the business was profitable, but had undoubtedly gone through a period in its early history during which for a few years the profits did not cover outlay and interest. As this plant was being purchased by a municipality, its value would not be subject to state regulation.

Speed and Cost of Proceedings

The arbitrators took their oaths of office July 24, 1917. The detail inventory was then made, the report was filed with the board of arbitration two months later, and by the end of January the value had been set. Compare this with the time consumed by the average rate-valuation case before a court or a public service commission. The writer has not been connected with a rate case before such a body which has taken less than 18 months for a decision to be reached, and then there often have followed appeals to superior and supreme courts.

The cost of the arbitration proceedings, exclusive of lawyers' fees to both sides, was only about 2½% of the value of the plant. This cost was charged equally to the borough and the water company in accordance with the terms of the contract, which also provided that if the borough had refused to buy the plant it would have had to pay the whole cost of the arbitration.

If, before throwing matters concerning water rates or valuation for purchase into courts and before public service commissions many of which are overloaded with work, the utilities and municipalities would agree to put these matters up to boards of arbitration composed of engineers they would, as a rule, get much quicker results, and I believe just as impartial results, and

at less cost. It is not the thought of the writer that boards of arbitration should replace courts and commissions in handling all such work, but it is a fact that, as more and more such work is disposed of thus, the strain on the judiciary and public service commissions will be lessened and prompter results obtained. Of course, where grave legal questions are involved, such matters would have to be solved by a legal body, but where simple matters of value only are involved the cumbersome machinery of courts or commissions is not essential, and results based on fairness and justice can be obtained by boards of arbitration promptly and inexpensively.

Another advantage of arbitration is that the decision is reached by men who are, usually, entirely familiar with the plant, meetings are held on the ground, and disputed questions can be settled by inspection of the article in dispute. A great deal of information and data can thus be obtained first-hand by the board or its members, and it does not become necessary to rely entirely upon often conflicting and prejudiced testimony.

An instance in point arose at Huntingdon. It was stated that a considerable amount of the pipe was laid in rock cut, and the board examined in a body certain sewer trenches then in process of excavation, as well as numerous test pits dug at selected points over the town, and made up its own mind concerning both the amount of rock excavation and the nature of it.

At another time, in order to settle certain questions relative to the class of cast-iron pipe used and its condition, a section of pipe which has been in use about 30 years was opened up and a section of it was cut, examined, weighed and measured by the arbitrators.

The practice of the Pennsylvania Public Service Commission is to order engineering conferences to be held between engineers representing the commission, the complainant and the respondent company. At these conferences the inventory is usually agreed upon, and often the complete reproduction value, less depreciation, and sometimes the historic cost. This conference of engineers reports its findings to the commission, and testimony is taken only on points not agreed to by the engineers. Often the operating expenses and rate of return have been agreed to at these conferences, as well as the segregation of the property between domestic and fire service. This is going a long step in the direction of decision by arbitration, but the trouble with this practice is that the commission's engineers cannot hand down decisions and must turn their results over to the commission, to await the long and tedious routine of procedure of testimony, argument and filing of briefs by attorneys.

Devastation Wrought by the Great War in Belgium, Serbia and Italy

By Major Daniel T. Pierce
American Red Cross, Paris, France

For the benefit of those contemplating professional work or business undertakings in the three countries named, concise reviews of the damage done and some of the general conditions prevailing have been prepared for "Engineering News-Record" by Mr. Pierce.—Editor.

Belgium: A Huge Total of Destruction

BELGIUM'S bill against Germany for damages has now been presented, at least in part. It does not include personal losses, which at the present time are being determined by tribunals throughout the country. These tribunals are open to the poorest householder, shopkeeper or farmer, and are making a record of every loss for which compensation is claimed, from a farm to a chicken. The statement is made on good authority, but not officially, that the personal losses, which include private structures of all kinds, the equipment of factories, etc., will equal the "state losses," the total of which, as submitted to the Reparations Committee of the Peace Conference, is $3,000,000,000.

The total just mentioned includes an item of $750,000,000 for damages and destruction of railways, posts and telegraphs. The other important items do not cover damage or devastation but refer to war expenditures ($600,000 000), war taxes paid to Germany ($500,000,000), the relief of the Belgian population ($100,000,000), etc. Taking the situation as a whole, west of Brussels the Belgian railways may be described as in a state of chaos. At regular intervals there are deep holes in the right-of-way, with the rails twisted and standing upright in the air. Innumerable bridges and conduits have been blown up, and all sorts of structures, such as tanks, towers and stations, have been demolished. One of my informants, who asserts that he was an eye-witness, says that as the Germans retired they mounted a heavy gun with a deflected muzzle on a flat-car and this gun, as it was drawn over the lines, was fired into the receding track. I should say that this was merely a novelty in the general program, for it is evident that the greater number of the culverts and other vulnerable spots along the line were blown up from below. I am told that conferences are already under way between the Belgian Government and American firms with a view to arrangements for the reconstruction of the Belgian roads. An enormous amount of material and labor will be required to put them into operating condition.

Not only the railways but the roadways were in many places systematically destroyed, the most effective damage being done, of course, by demolishing bridges, but here and there it is evident that mines were exploded under the solid roadbed.

On the Belgian state railways, out of a total of 4150 km. of track, 1100 km. have been completely destroyed and 410 km. "rendered useless." Destruction is especially severe in the Borinage coal valley, in and around Tournai; in the vicinity of Bruges, Ghent, Courtrai and Ostend. The whole railroad system of west and east Flanders is classed as practically destroyed.

The great bridges over the Meuse at Liège, Namur,

Dinant and Anseremme, as well as the bridges leading in and out of Ostend and Bruges, are classified as a total loss. On the Ghent-Terneuzen canal eight bridges were destroyed, notably the two important structures at Selzeate near the Dutch frontier which weighed 3,000,000 lb. each. The total destruction in weight of bridges in Belgium tot ls approximately 100,000,000 pounds.

The block-signal system of the Belgian Government railways was entirely removed and replaced by a German signal system which is now useless, since the Belgian locomotive drivers cannot read the signals. Telegraph lines, telephone wires and all portable stores and materials were likewise removed or destroyed.

The Germans appropriated 2614 locomotives out of a total of 4593, or 57%. They also removed 9062 passenger coaches out of a total of 10,812, and made way with 80,568 freight cars out of a total of 94,737 owned by the Belgian railways at the time of the outbreak of the war. The actual value of material, cars and locomotives taken away, plus the damages to the Belgian railroads, is placed at $1,000,000,000. This does not include damages to interurban steam railroads owned by private companies which have not yet put in estimates of their losses.

A Huge Total of Destruction

The number of dwellings and other buildings destroyed in Belgium is officially stated to be 45,000. Of these 20,000 were wiped out in 1914 and the remaining 25,000 destroyed in the following years of the war. If, however, one considers only the buildings ruined, he will get a very misleading idea of what Belgian cities and innumerable small villages have suffered. Louvain, Dinant, Dixmude, Ypres, Termonde, Roulers —to name only a few of the larger places—together make up a huge total of destruction, while Bruges, for example, would add only a few to the list of ruined buildings. But more than 60 of the 83 famous bridges of Bruges were blown up in the last days of the war, and their destruction is a far more serious matter than the demolition of an equal number of houses.

There is also a vast although invisible loss in the deterioration of all public improvements, on which little or no maintenance work was done for more than four years. This is likewise the source of very serious damage to canals. The locks and sluices have been neglected and allowed to rot. Channels have filled up and, owing to continued neglect, it will take a long time to restore them to operating condition. This is also true of the Antwerp port facilities. At the present time this port is in shape to handle only about 60% of the pre-war tonnage. The lack of oil and of cable has led to serious deterioration of all hoisting machinery. Wood, on the other hand, seems to have been relatively plentiful. The Germans brought in quantities of lumber, and among other things that they did not have time to take away with them were several million feet of timber, about 10 x 10 in. in size, now stored in great piles near Bruges.

According to the Belgians, the Germans acknowledged that the value of raw materials and machinery moved from the country up to January, 1915, was $400,000,000, and according to a semi-official statement made by a Belgian official to a representative of the London *Times* the value of material and other equipment carried away by the Germans since that day would greatly exceed the sum stated. Not only were whole establishments robbed of every scrap of equipment, but the country was systematically looted of brass and bronze, even the smallest ornamental metal work being removed. In some hotels the brass door knobs and bolts were carried away, as was reported during the war. In the neighborhood of Liège, where there were a number of steel plants, the blast furnaces, mills and construction plants have been totally denuded of all heavy tools and equipment; even the bellows were taken.

In the mines the damage is not nearly so great as was expected, perhaps because, as is certainly true in some cases, the Germans were deterred from destruction by President Wilson's threat of reprisal if such destruction were attempted. Throughout the war the coal mines were systematically worked, but only to about 50% of their capacity. Apparently, only electric motors and cables were removed. The lifts and galleries of the mines are in good shape, but because of lack of oil and misuse of tools it will be necessary to replace about half of the machinery. The coal mine at Limbourg is the only one reported ruined by the admission of water. The cement industry, which was making good progress, has suffered very little. An expert who has made a survey of this industry states that all it needs to go ahead is belts and bags, which at the present time are unobtainable.

In the glass industry, where the production was important and profitable before the war, the plants have been reduced to about 50% capacity, and important repairs must be made before the industry can resume. The cutting tables were the only equipment carried away, for some reason. Considerable stocks of sheet glass were left, but no bottles.

The textile industry is another one that has not suffered severely by destruction or the removal of machinery. Very few weaving frames were taken, and Belgium's wool, cotton, hemp and flax plants could resume at present on a basis equivalent to 70% of the pre-war output—if raw materials were obtainable.

Agriculturally, Belgium has not suffered nearly so severely as France. Except for a comparatively limited area in the fighting zone, all of the lands heretofore devoted to farming could be put back under cultivation immediately. Here again there is the possibility of the resumption of normal industry defeated by lack of tractors, tools and transportation.

Almost No Horses Left in Belgium

There are practically no horses left in Belgium, which for centuries has produced the most valuable heavy draught horses in the world. These were systematically collected and carried away by the Germans. At a small town near Poperinghe last year I found a patriotic old Belgian doctor who had, by purchase in France, got together an Andennes stallion and six mares which were, he told me, all that were left of this famous breed. This, of course, was merely the exaggeration of despair, but, so far as being available for work purposes is concerned, the famous Belgian draught horse has, in fact, disappeared from the country. The Government has arranged to buy 25,000 Canadian horses and is endeavoring to buy 100,000 horses from England, presumably those that have been used for military transport. Of farm animals, cows and pigs, hardly a trace remains, and eggs even at the present time (February) are almost a curiosity in Brussels.

It would be more satisfying if it were possible to give an official estimate of actual destruction in Bel-

gium, but this, as in other countries, is impossible, because such figures as have been used in making up Belgium's bill for damages include enormous items for losses other than those that can be called damage to property. They even include losses due to the fact that the industries of the Belgian Congo have had to be abandoned. But after even a motor-made inspection of the destruction of towns, villages and isolated houses, factories, mines and plants, it is easy enough to believe the statement already mentioned that those Belgian losses classified as personal will equal, at least, the state loss of $3,000,000,000.

Wherever figures in dollars have been stated here they have been arrived at by counting five Belgian francs to the dollar.

Serbia: Transportation System Nearly Wiped Out

ALTHOUGH physical devastation in Serbia is bad enough, it is not so bad as the social devastation resulting from the movement back and forth over the country of three hostile armies during a period of more than four years. The population of about 5,000,000 has been reduced by more than 1,125,000, and, worse than this, the loss is mainly among the younger and more virile part of the population. This has an important bearing upon the subject of reconstruction, for with all men between 20 and 50 mobilized and those who have not been killed still in the army and most of them out of the country, no supply of labor worth considering is available. Furthermore, Serbia was not a land of artisans but of farmers, 85% of the population being engaged in agriculture.

Serbia is now reaching out for the aid of the United States in rebuilding the country, and it is for this reason that some facts in regard to conditions that prevail both in old and new Serbia are included here, although they do not relate strictly to devastation. One of the ministers of the new "Government of the Serbs, Croats and Slovenes" (which is the name by which the Government of Serbia prefers to be known), who was in Paris in February, was asked what America could do; what America could supply. His answer was, "Everything." The country is literally denuded of finished products, such as clothes, furniture, hardware, prepared woods, metals and glass.

And, to make matters worse, the finishing blow to the country's ruin was struck in October and November of last year, when its transportation system was almost completely wiped out. The main line of railway traverses the country from north to south, extending from Salonika on the Aegean Sea to Nish and Belgrade, with a branch line to Semendria. A through highway, poorly constructed, with many steep grades, parallels the railway. The main line of the railway from Belgrade to Nish continues through Pirot and on to Sofia in Bulgaria, forming a part of the "Berlin-Bagdad Railway."

This main line, as well as many of the branch lines, was destroyed by the Germans, Austrians and Bulgarians as they retreated through Serbia in the last weeks of the war. Bridges, large and small, and almost innumerable culverts were blown up. As the road parallels the Vardar and Morava rivers, it was carried over many smaller streams emptying into these rivers. These multiplied the number of bridges to hundreds, and all are destroyed. There were only three tunnels, but these also were destroyed. The roadbed itself was not disturbed except near Belgrade, where mines were systematically exploded every 1000 meters.

The main highway was just as systematically attacked, all bridges being mined. Originally, there appears to have been a stone base in the road, but this is now covered with a deep layer of mud in which the ruts are so deep that heavy camions find it almost impassable. On the highway, by Dec. 31 the bridges between Skoplie (Uskub) and Semendria had been temporarily repaired. A surveying party which made the trip between these two cities by camion was 11 days on the road. The only effort then being made to fill the holes and ruts was the employment in a desultory way of a few Bulgarian prisoners.

Thus, the two main arteries of Serbia's transportation system are virtually out of existence so far as supplying the needs of the country is concerned. The railroad has been repaired as far as Skoplie, and late in December a temporary bridge over the Vardar at Strumitza was opened. Two weeks later it was reported that trains were running to Kumanovo, and it was promised that by the end of February trains would run as far as Vranja, but as this would mean the rebuilding of a number of important bridges it hardly seems possible of accomplishment. From Kumanovo to Semendria and Belgrade not a wheel is moving on the railway except for about 12 miles south of Nish where the road had not only escaped destruction but where a locomotive in operating condition had been left. By January the Nish-Sofia line had been repaired from the Bulgarian frontier as far as Pirot, but no effort was being made to open it between Pirot and Nish. Efforts of the French and English to operate camion service between some of the important towns are defeated by the fact that the trucks cannot negotiate the roads. The camions used were chain-drive, and most of the time was spent in replacing chains. Trucks must be very lightly loaded and must carry their own gasoline, as no gasoline is to be had in Serbia north of Uskub. To complicate the transportation problem, especially in regions off the main line of highway, practically no horses or mules remain. Their skeletons are scattered by the roadside for almost the entire stretch of highway from north to south. Oxen are a little more plentiful in the north.

So desperate is Serbia's need that she has made an urgent appeal for details of the United States Army to take charge of the reconstruction of the main line of the Serbian railway.

Property and Population Records Destroyed

As for records, national or local, there are none. The Serbian officials who have returned to their posts find that the Austrians and Bulgars who assumed charge of the local governments destroyed or carried away everything, and when the Serbian prefects came back to their posts they found only empty buildings. There are no records of either property or population except fragmentary reports prepared by the Austrians for the purpose of rationing the country.

When the fortunes of the war changed last year it seemed to have been a surprise to the hostile armies occupying Serbia. They had sent home great quantities of food and furniture when the shortage in Austria and Germany became acute. Now they pillaged the country of everything that remained. Into Austria and Germany were transported carload after carload of

furniture, bedding and clothing, so that at the present time even those who were comparatively well off before the war have nothing but the clothes in which they were standing when the enemy departed. In this sense Serbia is devastated throughout.

But in the sense of physical destruction the devastation is confined to areas extending in strips along the northern and southern borders. In the north, along the Danube, the cities have suffered severely. About half the buildings of Belgrade are damaged, and of this proportion about 20% may be classified as destroyed. Important parts of Belgrade, the capital, were destroyed when it was originally captured by the Austrians in November, 1914, and again when it was captured by the Germans in November, 1915. Additional injury was inflicted when the Austrians and Germans departed in November, 1918. The industrial portions of the city suffered more than others. The largest tobacco factory is now only a crumbling ruin. Of the two largest hotels one is completely destroyed, and the other is in such bad shape as to require complete interior reconstruction. The royal palace is not habitable, and the University of Belgrade is seriously damaged. All over the city are buildings which, while they appear from the outside to be intact, are found, on closer inspection, to be gutted. Semendria, about 30 miles east of Belgrade on the Danube, is in much the same condition as the capital. Shabatz, 30 miles west of Belgrade on the Save, is in even worse condition.

Along the southern boundary of Serbia, which was the battlefront during the period of occupancy, there was, of course, serious destruction. Monastir, the second city in size in Serbia, was badly injured by shellfire. Officials estimate that 35% of all the buildings in Monastir have been so badly damaged as not to be repairable. A great many small villages in this area may be classed as wholly destroyed so far as providing human habitation is concerned.

Innumerable Buildings Blown Up

In addition to the destruction in the extreme northern and southern zones, there is sporadic destruction all over Serbia. The worst of this is found in the region on the line of retreat of the hostile armies. Innumerable buildings were blown up. The railroad station at Leskovatz, in central Serbia, a large structure, is now a mass of ruins. In other towns one is struck by the evidences of a practice of blowing out the windows and doors of the buildings facing on the principal streets, and those who have recently made a journey of 320 miles through Serbia by camion say that their most vivid impression is that of an avenue of doorless and windowless houses. No glass is obtainable in Serbia, and the practice has already been adopted of bricking up wall openings to within 6 or 8 in. of the top, depending only on such light and ventilation as may come through the door when left open or from the apertures at the top of what formerly were windows. Besides actual physical injury, hundreds of buildings have been rendered useless for a long time by indiscriminate disposal of filth and the use of structures of all kinds for stables.

The coal mines in Serbia, never a very important factor, are not operating now. There is wood, but no way of utilizing it. The fuel problem is therefore very serious, and the street railway in Belgrade in December and January repeatedly suspended operation for lack of fuel. The lighting plant was operated only for a few hours in the evening. Here again we have emphasized the fact that the key to Serbia's rehabilitation and the thing that must precede all efforts at reconstruction is the repair of her transportation system.

Most of the foregoing facts were taken from the report of the survey completed in January by Homer Folks, chief of the mission sent by the American Red Cross to inquire into post-war effects in the countries of southeastern Europe.

Italy: Physical Harm Unexpectedly Small

UNLIKE France, Italy has failed to keep systematic records of the destruction of public and private property by the enemy. It is impossible, therefore, in the case of Italy to present even the approximate figures that are available for France. Upon inquiry of representatives of the Italian Government attending the peace conference in Paris, it could be learned only that certain figures showing damage to Italian towns would be presented, but at the same time it was stated that these figures included consequential damages, loss of use, etc., making them valueless for the purpose of arriving at a determination of the actual damage to property suffered by the towns within the war area. But from several surveys that have been made it is possible to give a rather definite idea of the damage.

The actual destruction of buildings and other physical properties in Italy, while sufficient to give rise to a great social problem, is less than one would expect. The greater part of the fighting between the Austrian and Italian armies was in Austrian territory. It is to be considered, however, that this territory is now in the hands of the Italians and will presumably remain in their hands, so that whatever reconstruction problem exists will be one with which the Italian Government will have to deal. The area in which destruction was suffered is limited by the fact that in the invasion by the Austrian army of northeastern Italy, the Italian army opposed so slight a resistance until the Piave was reached that there was not much destruction by shellfire, and in the Austrian retirement there was likewise little resistance after the enemy had been driven from the river.

Physical destruction is, therefore, to be found almost wholly in three regions: Along the Piave, where the Austrian invasion was stopped and at which point occurred the heavy fighting in the final great invasion; in the Val Sugana above Bassano, and in Val Lagarina near the frontier. The Piave runs through one of the fertile and populous districts of northern Italy. Val Sugana and Val Lagarina are in the mountainous regions on the northwestern frontier of the province of Veneto.

While modern artillery carries for great distances, it appears that the area in which anything approaching total destruction of buildings occurs is limited to a very few miles. On the Piave, for instance, where the heaviest fighting occurred over a period of a year, there are many buildings standing yet, intact or only slightly damaged, up to within 5 km. of the river. But within this area of 5 km. on both sides of the river the greater number of the buildings are either destroyed or more or less damaged. Further away from the river this destruction is the exception, not the rule, although in certain cities more or less serious damage to buildings is found, especially where large numbers of troops were quartered, and those in which some

effort at resistance was made during the Austrian retreat. A notable instance of this latter condition is the town of Sacile, a village of a few thousand population about 25 km. from the Piave. In this town practically every house was damaged and a great many were destroyed. The Austrians made a stand here and also had used the village more or less as a headquarters for some time, in consequence of which it had suffered seriously from air raids as well as from bombardment.

At Pardenone, a city of 16,000 inhabitants, 10 km. further east, only a few destroyed buildings were found, but there were many of which only the walls and roofs remained, the doors and windows having been removed and in some instances even the partitions and floors torn out to provide fuel. The buildings occupied by the poor were much less damaged than the finer structures.

There are no large cities on the Piave, but there are numerous small towns ranging in population from 13,000 downward. Treviso, a city of 40,000, is some 15 miles west of the Piave, and was not injured by shellfire, though a good deal of damage was done in some quarters by bombing. It is officially estimated that 16% of the buildings are in some measure damaged.

As a whole, the province of Veneto may be classified as agricultural. A belt including the territory 5 km. on either side of the river would embrace a population of about 175,000. Within this area the destruction is not in all instances complete, but it is officially estimated that there are 200,000 persons in this belt and adjoining it whose homes were entirely destroyed. In addition to these, there are undoubtedly an equal number whose homes were considerably damaged, but not beyond repair. The homes of still others were looted of all furnishings, but the buildings remain intact.

No Comparison Between Italy and France

It would be a mistake to draw any comparison between Italy and the devastated agricultural regions of France. The region in which the land in Italy has been seriously injured from an agricultural standpoint by shellfire and trench operations has been very limited. Except along the lower Piave there are few shell holes in the fields or along the main roads, and a great majority of the trees along the road which crosses the Piave at Nevassa are still standing practically uninjured. The general appearance of this region is in marked contrast to such a region as the valley of the Somme, which was fought over repeatedly and in which all vestiges of permanent construction have disappeared. The land in the Somme is pitted in every direction, as far as the eye can see, with shell holes, and crossed by an interminable tangle of trenches and barbed wire. There is little vegetation. The difference is partly due to the fact that the Piave formed a natural barrier and the fighting was across that river, while it was along the Somme.

Very few refugees have returned to the devastated regions of Italy; this is due partly, no doubt, to the opposition of the military authorities. This opposition is very effective, because the Government controls all means of transport and there are only a few temporary bridges across the Piave. One judges from conversation with Italian authorities that the return of the refugees is not thought to be immediately desirable or necessary, and no program has been worked out, as in France, for even a gradual return of the former inhabitants. The Italian Government has considerable hesitation about entering upon temporary housing on a large scale. Its attitude in this respect is due to the rather curious fact that the temporary houses in southern Italy provided after the earthquake still remain in use, and no steps have been taken there for permanent construction. Meanwhile, the temporary housing has become extremely dilapidated and unsanitary. The people of the north are undoubtedly more progressive, but the Italian Government is evidently desirous of avoiding temporary housing if possible.

The occupied territory covering all of northeastern Italy, going west as far as the Piave River, inclusive of the Asiago plateau, forms about 5% of the total area of Italy and provided homes for 4% of the population. Almost 1,000,000 persons remained in the occupied territory, and their care at this time constitutes a much more urgent problem than does the rehabilitation of the devastated region. It is a problem complicated by the destruction of the railways, the damage to the roads, and the blowing up of all the bridges across the Piave River.

As in the case of all the regions devastated by war operations, in all countries, it is well to remember that the problem of physical reconstruction of buildings, while perhaps the most engaging, is also the most remote. The disturbance of soils and the wrecking of such water and sewerage systems as existed have the most serious results, as would be expected, and it is the dangers from such sources that must be first met. For example, the typhoid fever death rate in northern Italy, which had fallen from 27 per 1000 of population in 1911 to 19 in 1914, is now, on the basis of very imperfect statistics, placed at 26 and is probably much greater.

Decay of Timber in Mexican Low Coastal Plains

Inspection of Line of Southern Pacific Railroad in Mexico Showed Badly Decayed Condition of Untreated Pine

By J. D. Mathews
Engineer Maintenance of Way, Southern Pacific Railroad of Mexico, Empalme, Mexico

SAGGING trestles and rotted ties were found during the inspection of untreated pine construction on the Southern Pacific R.R. of Mexico, while redwood ties and cedar piling well withstood the same conditions of dampness in warm, moist coast lowlands. Six years is the probable life limit of untreated pine trestle timbering in this climate of the lowlands of Mexico, and redwood would be an immediate economy, as the replacement of pine ties and timbering would have to begin in two years after installation.

In December, 1918, the writer made a trip of inspection to investigate the physical condition of the unoperated portion of the Southern Pacific R.R. of Mexico lying south of the town of Acaponeta, in the state of Nayarit—a distance of about 103 miles. The operation of trains over this portion of the line had been discontinued by the railroad company in 1913 owing to the revolutionary disturbances, but the continuance of operation was attempted by the military authorities, until some time in 1913; since that time the line has been idle, with no attempt at operation.

This portion of the line was constructed between 1909 and 1912, reaching the City of Tepic with the close of December, 1911. The timbers in use in the

track and trestles are still those of the construction, and have had a service of from 7 to 9½ years. Portions of this line saw but a few months' operation, and none of it saw more than two years', with occasional use by the military authorities during the third. The present condition of the timber, then, represents one of decay only, destruction under traffic or mechanical wear not being a factor.

Pine timbers and, generally, sapwood of all timbers, decay very rapidly in the coastal plains of continental Mexico, bordering the Gulf of California, and particularly so south of Culiacan, the capital of the State of Sinaloa. Thirty or 40 in. of rainfall per annum causes the soils to remain damp a considerable portion of the year. This, coupled with a warm, moist atmosphere and associated with a jungle growth of grasses, underbrush and trees, and the whole soil covered with a tangle of vines, produces a condition that causes rapid destruction of those woods that do not contain, either naturally or artificially, a decay-resisting agent.

Untreated Pine Susceptible to Decay

Untreated pine is particularly susceptible to this decay, and more so when sawed as stringers, caps, ties and guardrail Creosoted pine, used in bulkheads, has suffered but little in the nine years since construction. Untreated pine, however, has rotted in various structures until trestles are sagging from their own weight, as they have not carried the weight of traffic for nearly five years. Thus, in the space of nine years, and absolutely uninfluenced by traffic loads for the past five years, a number of these trestles have rotted to destruction.

Decay attacks most readily the exposed end fibers, and traverses them longitudinally under a sun-baked shell of frequently respectable appearance. Ties that will crush under foot not infrequently present an almost perfect appearance, externally. Entering the end of the sticks, decay penetrates caps and stringers, sometimes but a few inches, but often for several feet, and, in cases, the entire piece is affected. Points of contact, also, are locations of proneness to decay. Stringers decayed at the ends and over the center caps are useless as such, although the major portion of the stick may be sound. Decay of stringers over the cap produces decay in the cap, if of untreated pine. If of redwood, however, the caps will be practically unaffected.

End panels of trestles have suffered more than the centers, but the centers have been far from immune. This is undoubtedly due to the fact that the end panels are in a more continuous state of dampness, being closer to the steaming earth, and also are more continually immersed in the shadows of the adjacent trees. The center panels are frequently over the tops of the trees and face the direct rays of the sun—always an enemy to the destroying microbe.

Nevertheless, while the timber in the center panels of the higher trestles will, undoubtedly, give the longest period of service, yet, in these lowlands the maximum length of life of untreated pine, under the best conditions, will probably not exceed 10 years, while by far the greater percentage will have disappeared in much less time. Such timber is seldom placed under more favorable operating conditions than as decking for our steel bridges, many of them on this line being 50 ft. or more above the water. Few of these structures have been in place more than eight years, and, with this length of service, under the best of conditions a heavy percentage of their ties and guardrail is completely gone.

Pine cross-ties have suffered most severely of all. Panel after panel of these ties is completely gone. This does not simply mean "have become unserviceable to the point of removal," but they have gone till the rails, over which no traffic has passed in five years, are crushing them down, or the tie has completely disintegrated—its place being marked by a mass of shapeless rot.

The lesson of the experiences is that untreated pine, in these warm, moist coast lowlands, will give but a few years of service. The pine cross-ties ceased presenting a condition for service an unknown period of time ago, as, long before they reached their present condition, they would have been unsuitable for operation. It is probable that three or four years under traffic would have been their average life. Likewise, trestle timbers had for the most part long since decayed beyond the point that would have sustained operation. As with the pine cross-ties, we have to look backward for the limit of time to which these trestles could have been operated in safety. Many of them passed this limit not less than two or three years ago, some of them more. It thus follows that six years will be the limit of life for much of this trestle timbering of pine, while but little of it will see a life of 10 years.

Redwood and Cedar Well Preserved

On the other hand, cedar piling, redwood caps and posts and redwood cross-ties stand out in strong contrast to the destruction of the pine. For the most part, cedar piling is only now approaching the point when renewals must begin. Redwood ties, in a number of actual counts of ties in track, when tested by picking and hammering with prospecting picks, showed up not more than 5 to 10% more or less doubtful cases of renewals required to the rail, under precisely the same conditions that caused such excessive decay in the pine.

It thus follows that redwood, displacing pine for cross-ties and trestle timbering in everything but stringers, will be not an ultimate economy but an immediate one, as renewals will begin in all replacements in pine in two years, and be continuous until the last stick will have been removed inside of eight years, while, with redwood, the evidence demonstrates a minimum of service of eight years, with an average and a maximum yet undetermined, but it is safe prophecy to state that it will be several years over the demonstrated minimum.

While the foregoing discussion is confined to the territory south of Acaponeta, yet the same conditions obtain on the operated line, with practically undiminished force, in the vicinity of the City of Culiacan. Further northward there is a noticeable reduction in this excessive decay, until north of the Fuerte River the decay approaches normal. This establishes the limits of the territory in which it will be an operating economy to substitute redwood for pine wherever mechanically possible as the State of Sinaloa and the lowlands of Nayarit. As we leave the lowlands and the elevation increases, approaching the City of Tepic, decay again begins to become normal. Just where the southern limit of excessive decay lies is yet to be determined.

High Relative Temperatures of Pavement Surfaces

Thermometer Readings Taken on Surfacings and on the Adjacent Lawns Show a Variation of from 9 to 22 Degrees

By G. S. Eaton

Assistant Division Engineer, Universal Portland Cement Company, Chicago, Ill.

MAXIMUM temperatures of 124, 118 and 114° F. which were attained respectively by asphalt, brick and concrete pavement surfaces, according to observations made by engineers of the Universal Portland Cement Co., Aug. 6 and 7, 1918, were relatively high with respect to adjacent locations. From 11 a.m. to 6:30 p.m. the average readings for the three types of surfaces in the order named were 118, 113 and 108°. What the

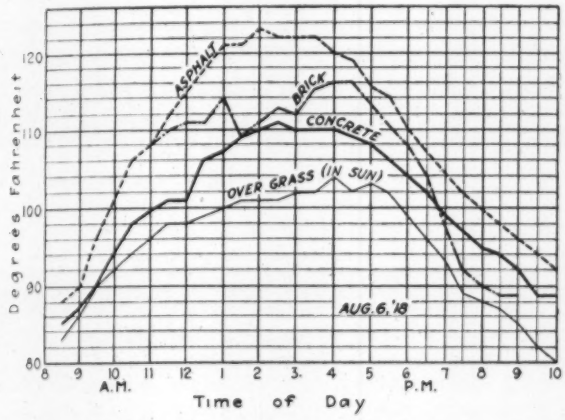


FIG. 1. SURFACE TEMPERATURES FOR VARIOUS TYPES OF SURFACING

effect of such temperatures on rubber tires, horses' hoofs and shoe leather might be is questionable. It is well known that a great deal of tire trouble is experienced in hot weather because of the expansion of the air in pneumatic tires. Pavement surfaces at high temperatures would undoubtedly aggravate this condition.

During the middle of the day the effect of the pavements in heating the air above them was noticeable, as thermometers 1 ft. and 4 ft. above the roadways read from 3½ to 4½° higher than over a lawn in the sun. Temperatures above the pavements were found to be much the same, however, regardless of the type of surface. Over the asphalt, the readings averaged 1° higher than above the concrete, and ½° higher than above the brick. After 7:30 p.m. the temperatures above the surfaces were practically the same as those of the surrounding air. The presence of large lawns and shade trees probably hastened the cooling and somewhat different results might be expected in the closely built-up sections of a city. Temperatures in the shade, 30 ft. away, were not influenced by the pavements.

The tests were made at Riverside, Ill., about 20 miles from Chicago. This place was far enough inland to escape the effect of lake breezes, and the three types of surfacing lay within a few hundred feet of one another. Absence of tall buildings and industrial plants

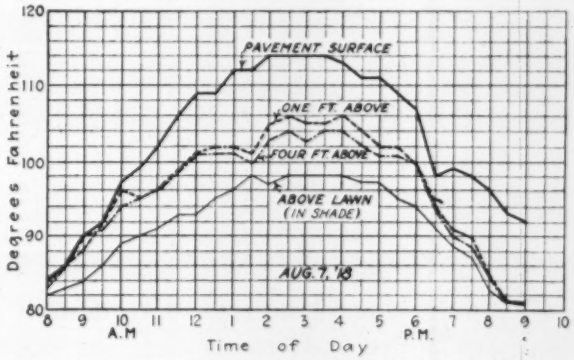


FIG. 2. VARIATION BETWEEN CONCRETE SURFACES AND VARIOUS ADJACENT LOCATIONS

with their accompanying smoke was another factor in the choice of location.

Weather conditions were ideal during the period. The sky was almost entirely clear, and the maximum temperatures recorded for the two days by the Weather Bureau at Chicago were 102 and 101°—the highest of the summer.

For each pavement, readings were taken at the surface, 1 ft. and 4 ft. above, and 30 ft. to one side of the roadway in the shade above a lawn. An additional set of readings was taken 4 ft. over grass in the sun. Thirteen standard 25-cm. Fahrenheit thermometers were used, each protected from direct sunlight by a white paper or pasteboard cover. Readings were taken every half hour from 8 a.m. to 10 p.m.

At the pavement surface the thermometer bulb was placed in a small groove about 1 in. long, ¾ in. wide and ⅜ in. deep. The groove was then filled with mercury to facilitate the transmission of heat between the pavement surface and the thermometer.

Figs. 1, 2 and 3 show graphically typical sets of readings plotted between temperatures as ordinates, and time of day as abscissas. Fig. 1 shows the difference between the various pavement surface temperatures and also the readings over a lawn in the sun. The drop in the brick temperature curve at 1:30 p.m. was due to the moving of the observation station on the brick pavement on account of the encroachment of shade. No point could be found on the brick surface that was in the sun for the entire day. The rapid drop in the same curve between 6:00 and 8:00 p.m.

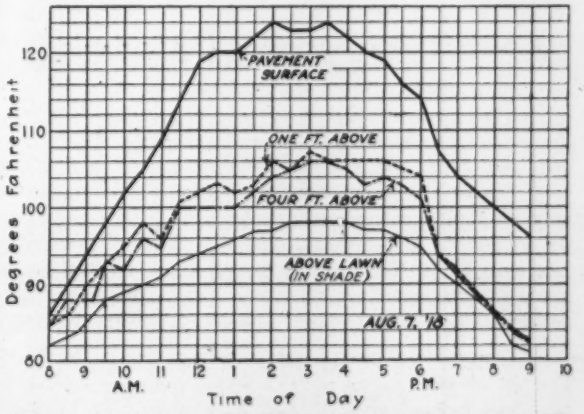


FIG. 3. VARIATION BETWEEN ASPHALT SURFACES AND VARIOUS ADJACENT LOCATIONS

was probably due to the proximity of the Des Plaines River, as air temperatures taken near by showed a similar drop.

Fig. 2 shows the relation, for a concrete pavement, between temperatures at the surafce, 1 ft. above, 4 ft. above and in the shade 30 ft. to one side of the roadway. Fig. 3 shows the same relations for the asphalt pavement.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Navy and Fleet Corporation Unfair to Their Own Draftsmen

Sir—In *Engineering News-Record*, Feb. 6, 1919, p. 298, I noticed a letter from Lloyd W. Weed commenting upon the wage award granted engineers in the Navy Department and the shipbuilding trades. He has quoted the War Labor Board's ruling of Oct. 1, 1918, effective immediately thereafter.

This explanation of what the Navy Department has done for engineers in general is absolutely wrong. The War Labor Board's awards were put into effect by the Emergency Fleet Corporation, and certain steel firms were forced to put in the rates under threats of cancellation of their contracts by the Secretary of the Navy.

The War Labor Board's rating was not put into effect in the Bureau of Yards and Docks and the different navy yards of the country. On Jan. 31 the Secretary of the Navy refused to make the awards retroactive to Oct. 1, 1918, and, also, the men of classes A, B and C, etc., were put in lower classes than their education and experience, of which an oath was taken, called for by the War Labor Board's ratings. This condition exists in general in the Bureau of Yards and Docks and the different navy yards. In addition to this, these increases in salary were made effective in the Bureau of Yards and Docks and in the navy yards about Feb. 5, 1919. WILLIAM F. FOX.

Lawrence, Kan.

[Following the receipt of this letter and many others of the same purport, this journal addressed a letter to the Secretary of the Navy, asking for an official statement in the matter. The letter printed below was received in reply. From that and from information received from other sources, we are convinced that both the Navy Department and the Emergency Fleet Corporation have not followed the spirit of the Macy award with their own employees, but have applied it only to their contractors' employees. There seems to be no doubt, furthermore, that the Navy Department has resorted to the subterfuge of a reclassification to avoid the raising of wages among Navy draftsmen. Secretary Daniels' letter, dated Feb. 25, follows:—EDITOR.]

Sir—Referring to your letter of Feb. 19, 1919: Upon receipt of the award of the Shipbuilding Labor Adjustment Board (Macy board) on Oct. 29, 1918, the department, under date of Nov. 12, issued instructions to the navy yard service to submit recommendations for a readjustment in the pay of the drafting force, based on the above-mentioned award. Upon receipt of the recommendations, they were turned over to a board appointed within the department to analyze, reclassify if necessary, and submit final recommendation in each individual case. This board submitted its report to the department Jan. 17, 1919, and under date of Feb. 4, 1919, the department issued instructions to the several bureaus in the department concerned, and to the navy yard service, to make certain revisions in their original recommendations as to the readjustment in the pay of the drafting force recommended by said board, and to then immediately put into effect the increases.

It is believed at this time that the readjustment under the Shipbuilding Labor Adjustment Board award has been effected throughout the service.

JOSEPHUS DANIELS.
Washington, D. C. Secretary of the Navy.

Letting Road Contracts in Long Stretches

Sir—I desire to express my approval of your editorial of Mar. 13, 1919, entitled "Letting Road Contracts in Long Stretches." The thoughts expressed bear out the conclusions I have drawn from a three-year intensive study of the methods of highway construction. The argument as it has come home to me runs about as follows:

The road building ahead of us is probably the biggest construction job that this country has ever had. The roads must be produced, not only in quantity, but quickly; and they must be built better than ever before. They must be *manufactured* as a standard product, as other commodities are manufactured.

Road building, from now on, must be considered an industry and, as such, will require large capital, large plants, large organizations and able men. The writer believes that the organizations, the capital and the men all will be forthcoming just as soon as the various states, counties and the Federal Government realize that the contracting must be done in a much bigger way than heretofore.

Contractors, in assembling their plants, have heretofore purchased individual *machines* instead of a coördinated group of machines that might be assembled into what we may call a *road-manufacturing* plant, where each machine is designed or selected as an integral part of the plant instead of an independent piece of apparatus. In the past one of the chief errors has been an unbalancing as among the capacities of the various elements of the plant. A mixer of large capacity, for example, has been idle for lack of material, due either to inadequate transportation facilities or to inadequate handling devices or storage at the receiving point. In other words, the plant has been unbalanced—uncoördinated.

It is a simple matter to lay out a plant that will enable the contractor to work his concrete mixers to capacity and to keep every one of the machines working efficiently, but that requires an investment of from $100,000 to $150,000. Such a plant will have a capacity of 15 to 20 miles per season. A road job five miles long, to be efficiently handled, however—handled so that each machine element works continuously at full capacity—will require the same amount of equipment.

The contractor should charge off at least 33⅓% of his investment per annum, to take care of depreciation, interest and repairs. In other words, a fully equipped contractor has a plant overhead to carry of $35,000 to $50,000 per annum. It is not reasonable to charge this against a few miles of road. It should be charged against just as many miles as it is possible for that plant to turn out in a full season's work. With a contract for only five miles of road, however, the contractor needs to procure at least two, and perhaps three, more contracts during a season in order to be successful. But if he were given one contract for 15 or 20 miles of continuous road, he would not suffer the delay of moving the plant from one job to another, nor delays in procuring additional contracts. His entire thought and energy would be concentrated on one job.

Contractors, in an endeavor to hold down their investments, instead of purchasing a complete plant, often sublet parts of the work. But the investment in equipment is there just the same, and *somebody must pay for it.*

Another element favoring the large, coördinated plant lies in the fact that there is no branch of construction work that can be so nearly standardized as road building. The building of one mile of road of any kind cannot differ much from the building of any other mile of the same kind of road. The plant is a standard one; no fear that it must be disposed of when one job is finished, for it can be used just as economically on the next job. In this, road plants differ from the plants required for the construction of buildings, bridges, dams and other classes of work which must be planned differently each time to meet special conditions.

Again, a desirable class of workers soon to be available may best be employed in handling plant, rather than in doing manual work. It has been urged that road building should immediately go forward to give employment to the men of our returning armies. It is submitted, however, that our boys are not coming home with any idea of doing pick-and-shovel or wheelbarrow work. The days of hod carrying are over. These men have been highly trained in organization and coöperation. The war has been won largely by machinery, and our armies have been trained to handle and to care for that machinery.

Even if a soldier were a common laborer before he went away, he is coming home with a broader vision of things, with more ambition, a better education and a desire—even a demand—for a better class of employment than he left behind. In short, the men returning from abroad will be exactly the sort of men that we shall need in a large contracting organization, handling large machinery installations.

Furthermore, common labor is becoming ever scarcer and more uncertain. Fortunately, well designed plants require comparatively few men, and may be expected to go far toward stabilizing the road-building industry by improving the class of labor employed and reducing the labor turnover.

On the other hand, because it is impossible to use properly coördinated plants on the short sections in which the work has been let in the past, the present price of hard-paved roads undoubtedly is higher than it should be. Ultimately, the use of proper plants will reduce the cost of the roads, just as large factories, running on quantity production, reduce the cost of any other commodity.

When engineers and contractors come to realize the possibilities of well coördinated plants, they undoubtedly will plan their work accordingly. Contracts will be let earlier, so that construction may start as soon as the frost is out of the ground in the spring. Contracts will be for longer stretches of road, so that the plant will continue in operation until stopped by bad weather in the fall.

Road building on a large scale is undoubtedly a business to engage the attention of large capital and capable organizations. Let those engineers who have a large mileage of roads to build award the contracts for a few large sections, rather than for a number of short sections as in the past, and there is no doubt that more of the contractors who have been engaged in big work along other lines will be attracted to the new field.

WILLIAM ORD,
Manager, Paving Department, Lakewood Engineering Company.
Cleveland, Ohio.

Would Use French as International Language for Engineers

Sir—I have read with much interest the letter in your issue of Feb. 27, p. 442 entitled "International Language for Modern Engineers," as well as certain other articles on technical publicity. Either of these subjects alone is of the greatest importance to the modern engineer and the engineering profession, but they are at bottom really closely inter-related, as the latter can be realized or obtained in its most comprehensive and broadest scope only through the former.

The writer of the article referred to seems to possess a full realization of the importance of an international language for modern engineers, but, as he says, is probably too prejudiced, on account of his position as chairman of the propaganda committee of the Esperanto Association of North America.

The necessity of technical publicity is being more and more fully realized every day. As a result we have the recent remarkable advance in the growth and activities of local societies. Also, as noted in your issue of Feb. 27, p. 439, a leading consulting civil engineer, L. P. Wolff, proposed that the American Society should set aside $10,000 annually for publicity work; $50,000 to be paid to five writers to furnish engineering articles for the daily and Sunday papers, the balance for expenses of inaugurating and maintaining the work.

Why not adopt French as the international language? It seems the logical one. Already it is the international diplomatic tongue—why not the international engineering tongue? Not only is it the easiest to learn, but, in addition, the majority of engineers already have a good foundation in French or in Latin—which is very similar to French—or perhaps in both, as both these languages are in the curricula of most high and preparatory schools and engineering courses of most technical institutions and universities. To cite my own case as a typical example—in private school it was ordained that I study both French and Latin as a necessary preparation for whatever might follow; in high school both were in the curriculum and had to be pursued; at college it was a choice among French, Spanish and German in the department of civil engineering. French

being by far the choice of the largest number; and, lastly, at the Military Academy at West Point French was compulsory.

One requisite in obtaining publicity is very aptly expressed in an editorial in the issue referred to above (Feb. 27), p. 407, entitled, "How to Get Local Publicity." It is this: "In the last analysis actual flesh-and-blood contact must be made. The more human it is the better the result." This is a true premise, and the logical deduction is that the best way to get widespread or international publicity is through the French language, the language of the country which is the very soul of the "flesh-and-blood contact" of nations today. France exerts a powerful influence over the minds and lives of millions of men of many different nations who have fought on her soil. The French language already has a big impetus in other countries through the words and phrases of everyday life brought back by returning soldiers and perpetuated in songs and poems both on and off the stage.

Furthermore, tendencies seem to indicate a further growth in the study and teaching of the French language in the future. I hope that every one interested in the use or adoption of an international language for engineers will seriously consider the advantages and merits of the French language.

WILLIAM A. CALLAWAY,
Second Lieutenant, Corps of Engineers, United States Army.
Camp A. A. Humphreys, Virginia.

Defines Right-Hand Door and Comments on Concrete Floor Finish

Sir—I read Mr. Conrad's letter in your issue of Jan. 23, 1919, p. 201, on how to determine the hand of a door, and thought that it would be answered quickly and in a practical manner. However, there has been so much delay in answering the question, and the one given in your issue of Mar. 6, p. 485, is so unsatisfactory, that I am going to give my definition of a right- and left-hand door. I hesitate somewhat to write to your paper, inasmuch as I am a member of the B. M. & P. I. U., and also because I read in a recent issue of your paper that the "outstanding characteristic of union labor is selfishness"—which goes rather against the grain.

Place yourself squarely in front of the door of the room you are about to enter. If the door swings around to the left and away from you it is a left-hand door. If the door swings around to the right away from you it is a right-hand door. If the door opens toward you and then swings to the left it is a left-hand reverse; if the door opens toward you and swings to the right it is a right-hand reverse. A left-hand door and a right-hand reverse door describe the same thing.

The writer has had charge of several structures and at no time has he failed to compare correctly in respect to the hand of doors when listing hardware for the interior trim of a building. I trust this explanation will be sufficiently lucid to aid Mr. Conrad in his perplexity.

The article by William McGinnis in the issue of Mar. 6, p. 477, was hardly a finished treatise on cement finish. I refer to the article as a whole, but in particular to the indefiniteness of the treatment of the concrete with acid. No mention was made of the thorough removal of this necessary before the application of grout and cement—or was it taken for granted? One of the most difficult things to do in concrete work is to apply cement finish on a concrete sub-base that has been placed for some days. I do not take exception to the method of screeding described, but do believe the proper amount of detail was omitted.

THOMAS P. MORRISSEY.
Springfield, Mass.

Some Additional Approximate Formulas for Structural Work

Sir—In your issue of Mar. 13, 1919, p. 534, you published an interesting article entitled "Approximate Formulas Useful in Structural Design," by R. Fleming. The following formulas, similar in character to those in Mr. Fleming's article, have been very useful and I send them to you in the hope that they may prove helpful to other engineers.

Approximate Weight of Angles—Multiply the sum of the widths of the legs in inches by the thickness in thirty-seconds of an inch. Divide the result by 10. Thus, for a 4 x 3 x $\frac{3}{8}$-in. angle, $(4 + 3)\ 12 = 84$. The weight in pounds per foot is 8.4.

Approximate Strength of Crane Chain, Safety Factor 4—Square the size of chain in eighths of an inch. Divide the result by 10. The answer will be in tons. For example, a three-quarter chain is six-eighths thick, and $6 \times 6 = 36$. The chain is capable of carrying 3.6 tons.

Resisting Moment of a Row of Rivets About Its Center of Gravity—Number each rivet consecutively, beginning with 1. Add these numbers together and multiply by the stress S on the outermost rivet. If the spacing of rivets is 3 in., the product will give accurately the moment of the row. For any other uniform spacing, divide by 3 and multiply by the given spacing. Thus, for a row of five rivets, spaced 4 in. on centers, and having the outer rivet stressed to 2000 lb., the moment in inch-pounds is

$$(1 + 2 + 3 + 4 + 5) \times \frac{4}{3} \times 2000 =$$

40,000 inch-pounds.

HARRY K. ELLIS,
Assistant Engineer, Bureau of Highways.
Philadelphia, Penn.

Wages Small Part of Ship-Operating Cost

According to J. H. Rosseter, director of operations, United States Shipping Board, there is an entirely wrong impression abroad regarding the effect of high wages for seamen on the cost of operating American ships. As is well known, United States laws require a higher wage scale on ships under American registry than do the laws of any other country. Mr. Rosseter, however, points out that under conditions now prevailing wages constitute only 7% of all ship-operating costs, so that a large percentage of increase in wages will have only a small effect on total operations. He stated that at present it costs $500,000 more to construct a 10,000-ton cargo carrier on this side of the Atlantic than on the other side. In this case, the American-built steamer has a capital charge of $6500 per month more than the European-built vessel, whereas the total wage cost of operating the boat is only $4000 a month.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Concrete Under External Hydrostatic Pressure Made Water-Tight

IN BUILDING a sump and pump chamber in the subway tunnel under the East River in New York, a successful method of making water-tight the concrete walls, that were under an external hydrostatic pressure, was used. It was necessary to construct the sump outside the cast-iron tube, and air had to be used. The concrete was placed under a pressure of about 11 lb., and when the air was taken off it was found that the pressure had made the concrete so porous that under atmospheric pressure the water in places came through in fine needle streams. After discussing several methods of waterproofing, it was decided to try out a simple expedient at first. If this had not been successful a more elaborate process would have been necessary. The chamber was again put under air pressure. The walls of the chamber were then liberally swabbed or painted with a thick grout mixed of the consistency of about one bag of cement to half a bucket of water. The air pressure forced the grout into the holes and closed them up. The air was again reduced to normal and places were noted through which the water still leaked. These were marked and later the pressure was again put on, the holes being fed with the grout until they were completely stopped up. When the pressure was again reduced to normal it was found that the process was entirely successful and the chamber was as dry as a bone.

Other Articles in This Issue of Interest to Contractors

Camp Utility Operation by the Construction Division of Our Army — Page 600
Unit Costs Lowered Without Cutting Wages — Page 605
Winter Concreting on Miami Conservancy Work — Page 617
Sanitary Service Rids Construction Camp of Influenza — Page 619
Devastation Wrought by the Great War in Belgium, Serbia and Italy — Page 626
Letting Road Contracts in Long Stretches (Letter) — Page 631

Tests of Frozen Rope Indicate Slight Loss of Strength

A RECENT test indicates that being frozen does not, as has been generally believed, greatly lessen the breaking strength of fiber rope. Four specimens were cut from a 3-in. manila rope. All were spliced at each end with an 8-in. splice. The length between the splices was 6 ft. Two specimens were soaked in water for 45 min., then exposed to an 18° temperature from 5:30 p.m. to 9:30 a.m. Both were stiff with frost when tested. The other two specimens were kept unfrozen. Elongation, at 50%, 1¾ in., and at 80%, 2 in., was the same in all specimens. The breaking strains were, for the frozen rope 10,000 lb. and 10,900 lb., and for the unfrozen rope 11,000 lb., and 11,300 pounds.

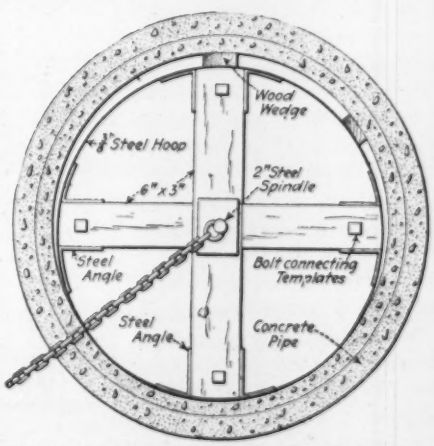
This experiment was conducted by Fred A. Jenks, Plymouth Cordage Co., Plymouth, Mass., to answer an inquiry by the editor. Mr. Jenks comments as follows:

"The results were rather surprising. It was expected that the unfrozen rope would show a much larger breaking strain, comparatively. As soon, however, as pull began to be exerted on the frozen rope the frost particles began to break up. After the rope had broken, the portion under stress was absolutely clear of frost, although in the splices, where the strain was on the double, the rope was still somewhat stiff from frost, and the ends of the tucks were completely frozen. Between pulling centers there was practically only a damp rope at the time of rupture. The pull had not only broken the frost crystals, but the heat generated by the friction in the strain and breaking of the rope had melted the frost. However, despite the showing made by the tests, everyone who has handled frozen rope knows that it cannot be as easily handled or run as freely over sheaves or used as well over capstans, and that it is much more difficult to secure. These facts alone constitute good reasons for protecting rope from frost."

Concrete Sewer Pipe Transported by Rolling to Place

BY L. MCLAREN HUNTER
Ottawa, Canada

IN THE construction of the Rideau Interceptor, the work of conveying the concrete pipe from the point where the pipe contractors had dumped them caused



ROLLING SOLVED PROBLEM OF TRANSPORTING PIPE

delays and entailed great expense. At first a track was built and a light carriage made. This was drawn by a horse to the derrick, but the lifting and laying of track always delayed the work of pipe laying for several days.

The difficulty was overcome by providing two templets, as shown by sketch, which were inserted in the pipe, each section of which averaged 3700 lb., and tightened by wooden wedges. Through the center was a 2-in. steel spindle which protruded about 9 in. at each end.

A team was hitched to this and the pipe was drawn to the job like a large roller. With this device there were no delays in pipe laying.

Care was taken to see that the pipe met no obstructions on the path, and apparently they suffered no damage by the operation.

Turntable Mounting Extends Reach of Stiffleg Derricks

TOWER derricks used by the Foundation Co. in its New Orleans shipyard have an ingenious turntable mounting, by which a derrick of given length of boom commands a larger area. It is shown by the drawing.

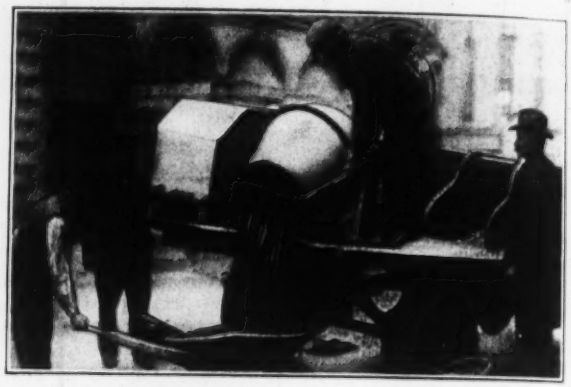
The derricks themselves are standard machines made by the Edward F. Terry Mfg. Co. They are set on wooden towers 32 ft. square, ranging from 35 to 48 ft. in height, in order to bring the derrick step above the deck level of the ship; the 48-ft. towers are near the head of the ways where the ship is highest above ground. The derricks have a capacity of five tons at 75-ft. radius, or 15 tons at 45- ft. radius. A timber base frame carries mast, stifflegs and engine. This frame bears through four wheels on a circular track rail resting on the tower top, and the derrick can thus be turned to face in any direction. The mast of the derrick centers over any one of the corner posts of the tower, when the frame is swung to proper position. On top of each of the four posts is a heavy bearing block, steel shod, and the mast can be brought to bear on this block by means of a screw jack fastened in the derrick base frame. Two other screw jacks at the rear ends of the sills transmit any uplift to the tower posts. A steel hook-shaped fitting attached to each bearing block projects inward over the the turntable and prevents its lifting.

By turning down the screw jack into a socket in the top of the bearing block, the mast is given firm support and the turntable locked in position.

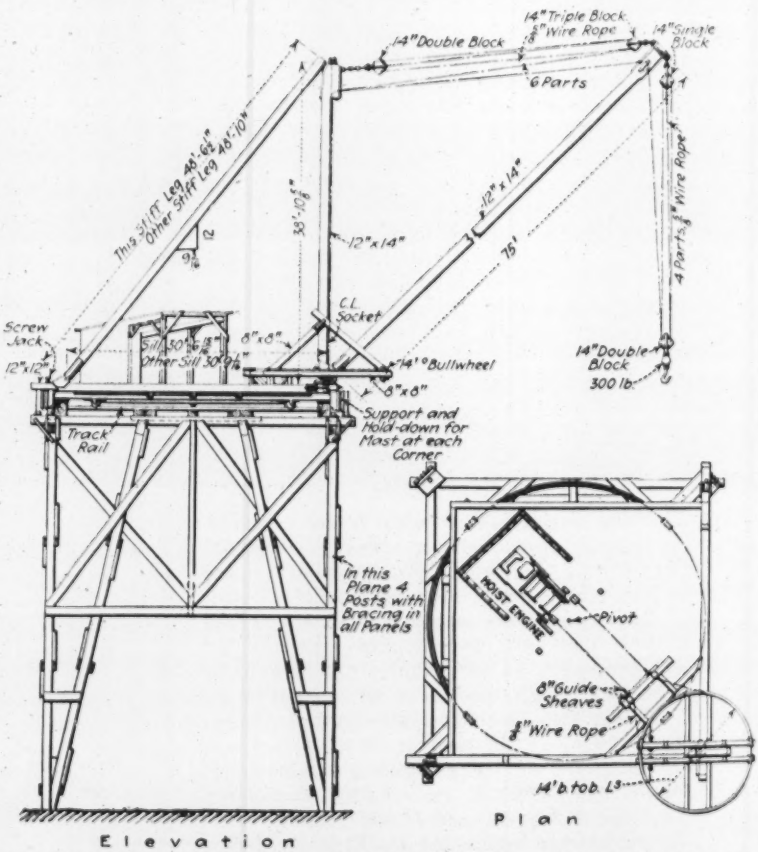
The derricks at the New Orleans yard have 75-ft. booms, but through the arrangement described they are enabled to command an area of about 100 ft. in radius.

Mixer Mounted on Street Repair Truck

TO HANDLE the concrete work of small street-repair jobs, the City of New Orleans had a 11-ft. mixer mounted on a 3-ton truck on which material bins of 1-yd. total capacity are also built. This leaves space enough to carry the necessary cement, which is often piled against the open end of the bins to increase their capacity. One man standing on the truck places the stone, sand, cement, and the water in the mixer, which he dumps over the end of the truck as each batch is mixed. The outfit is owned by the Department of Public Property.



USING NEW ORLEANS' TRUCK-MOUNTED MIXER



TOWER DERRICK WITH TURNTABLE MOUNTING HAS 100-FOOT EFFECTIVE REACH WITH 75-FOOT BOOM

NEWS OF THE WEEK

New York, March 27, 1919

American Society Convention to Be Held June 17-20

The annual convention of the American Society of Civil Engineers will be held this year in St. Paul-Minneapolis June 17-20, according to decision by the Board of Direction. The last June convention was held in Pittsburgh in 1916, the St. Paul-Minneapolis meeting scheduled for June 12-15, 1917, having been indefinitely postponed on account of war conditions.

The committee of the board in charge of arrangements consists of W. L. Darling, E. E. Wall and Charles Warren Hunt. The local convention committee consists of the following members: W. C. Armstrong, Frederic H. Bass, R. B. C. Bement, F. W. Cappelen, Oscar Claussen, William de la Barre, F. E. House, W. H. Hoyt, W. N. Jones, F. C. Shenehon, Horace E. Stevens, Howard E. Stevens, P. E. Thian, W. T. Walker, George L. Wilson, L. P. Wolff, R. D. Thomas.

Railroad Construction Work Stopped

By order of the Railroad Administration, all new railroad work in the way of betterments, additions or new lines will be held up, owing to the failure of Congress to provide the necessary funds. Only such construction is to go ahead as is necessary to insure safety or to protect contracts already entered into.

National Chamber Urges Private Aid to Employment Work

In connection with the recent appeal of the United States Employment Service, that communities and business interests carry on the work, as far as possible, until such time as adequate funds may be provided by Congress, the National Chamber of Commerce of the United States has issued a call to commercial organizations of the country, urging them to assist in every way possible in placing returning soldiers and sailors in employment.

War Department Will Receive Bids on Cantonments April 15

Bids will be received Apr. 15 for Army camp material, including buildings, railroad tracks and sewerage systems, to be abandoned by the War Department. The plan is to sell entire camps for lump sums, and big industrial concerns are regarded as the most likely purchasers. In some cases, state governments are expected to bid for the camps for use as National Guard training centers. Such bids will have preference.

Thirteen camps to be sold on Apr. 15 include all the War Department has definitely decided to dispose of. Others may be sold later. The 13 are: Camp Beauregard, Louisiana; Bowie, Texas; Colt, Pennsylvania; Hancock, Georgia; Kendrick, New Jersey; Logan, Texas; Polk, North Carolina; Sevier, South Carolina; North Camp Jackson, South Carolina; Shelby, Mississippi; Sheridan, Alabama; Wadsworth, South Carolina, and Wheeler, Georgia.

Division storehouses and the utilities serving the storehouse area are excepted from sale.

Tentative bids have been received from the State of Louisiana for Camp Beauregard and from Alabama for Camp Sheridan, the expressed intention in each case being to utilize the sites for the mobilization of state troops in case of emergency.

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Engineering Societies Employment Bureau; secretary, 29 West 39th St., New York City.

American Association of Engineers, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, maintained by the Joint Council of Engineering Societies of San Francisco, Engineers' Club, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

In the general cut in the United States Employment Service it has been found necessary, officially, to abolish the offices of the Professional and Special Section, but it is hoped that this work may be continued by local interests. As mentioned in these pages last week, the Military Training Camps Association at Chicago has already taken over the work of the Professional and Special Section office in that city.

Engineers Discuss Plans for Vehicular Tunnel

Size and Design of Proposed Hudson River Tube are Unprecedented and Suggest Many Difficulties

Plans for the proposed vehicular tunnel under the Hudson River at New York City were discussed at a meeting of the American Society of Civil Engineers Mar. 19. The society has seldom held a session at which greater interest was manifested. While several different designs were described, the main interest centered around the one adopted over a year ago by the New York and New Jersey Bridge and Tunnel Commission. Arguments both for and against this design were advanced, and the great number of uncertain conditions to be met, due to the unprecedented size of the tube and of the shield to be used, were brought out by expert tunnel men. The state Reconstruction Commission, to which Governor Smith of New York is referring such projects, assisted by an advisory committee of engineers nominated by the Engineering Council, had held a public hearing on the project Mar. 12 and several of the engineer committee were present at the meeting of the society Mar. 19.

The plans, which were adopted by the tunnel commission, are for a tunnel 42 ft. in diameter, to be built according to novel methods originated and patented by John F. O'Rourke. As described by Mr. O'Rourke in *Engineering News-Record* of Mar. 21, 1918, p. 563, the tunnel is to be driven with a shield having its face divided by horizontal partitions into separate compartments in which different pressures of compressed air are carried, according to the hydrostatic pressure in the earth penetrated. The tunnel is to be lined with precast concrete blocks instead of cast-iron segments, and is to have the space back of the shield filled with gravel blown in by compressed air, instead of the usual grout filling. The O'Rourke plans have been approved by Gen. George W. Goethals, consulting engineer to the New York and New Jersey Bridge and Tunnel Commission.

Some of the questions which must be settled before the practicability of the large-diameter tunnel can be affirmed were stated by Paul G. Brown in his remarks at the Civil Engineers' meeting as follows:

Can a tunnel such as this proposed be ventilated?

Can a shield 43 ft. in diameter be constructed of sufficient strength without prohibitive weight and expense?

Would premolded concrete blocks

have sufficient strength to withstand the thrust of such a shield?

Could premolded concrete blocks of the design suggested be made watertight?

Would premolded blocks of the design suggested have sufficient strength to support the tunnel structure?

Is it possible to maintain compressed air of several stages of pressure in the face of a shield?

Can a shield of such size and length be kept to line and grade?

It is a well known fact that a shield, if it cannot move ahead, will move downward, and if such a shield did settle, could it ever be brought up to grade again with the projection of the lower part acting as a cantilever?

This shield is 93 ft. below mean low tide or 20 ft. lower than would be necessary with a smaller tunnel with correspondingly lower air pressure. In the bottom chamber through the rock section the "sand hogs" would only work short hours. The shield could move no faster than the bottom chamber. Would this make the progress so slow that the cost would be prohibitive?

Can any system of concrete blocks be designed for the North River that would be a proper substitute for the usual cast-iron lining?

Would the congestion of traffic at the terminals due to the concentration into one tube prohibit that type of construction?

Would two single tubes, if carrying two lines of traffic in each direction, be sufficient for the present traffic needs?

What units of cost are used in making the estimate of $11,500,000 for this tunnel?

The discussion was notable for the number of well known engineers experienced in soft-ground tunnels who participated, including J. Vipond Davies, James Forgie, W. C. Parmley, A. F. Byrne and Fred Lavis. Replies to various criticisms of the tunnel design were made by John F. O'Rourke.

The engineers advising the Governor's reconstruction commission have recommended that the whole matter of the designs and estimates for the Hudson River vehicle tunnel should be referred to a board of engineers to investigate and report as to the best plan.

Kansas City Cannot Make Ice

A proposed $400,000 bond issue to provide money for a municipal ice plant for Kansas City, Mo., has been declared unconstitutional by the Supreme Court of the state on the ground that ice-making is a private enterprise and the city cannot engage in private enterprises. The decision was six to one. The dissenting judge held that ice is a prime necessity in cities and its manufacture for the protection of the health of the people is an exercise of the police power. There is said to be talk of an application for a rehearing. E. M. Harber is city counselor of Kansas City.

New President of American Railway Engineering Association

Earl Stimson, elected president of the American Railway Engineering Association at the annual meeting last week in Chicago, was appointed, in August last year, general superintendent maintenance of way and structures of lines under the jurisdiction of the Federal manager of the Baltimore & Ohio R.R. Lines East. He received his technical training at the University of

EARL STIMSON

Cincinnati and at Cornell University. In 1895 he entered the service of the Baltimore & Ohio R.R. as a rodman. His service has been with the Baltimore & Ohio and affiliated lines ever since.

In 1898 he was made assistant division engineer at Chillicothe, Ohio, and in 1901 division engineer at Flora, Ill. Four years later he was appointed engineer maintenance of way of the Baltimore & Ohio Southwestern R.R., with headquarters in Cincinnati. In 1910 he went to Baltimore as chief engineer maintenance of way of the Baltimore and Ohio R.R., succeeding A. W. Thompson, who became chief engineer and who lately resigned as Federal manager of the Baltimore & Ohio and associated lines to become president of the Philadelphia Co., Pittsburgh. On Aug. 1, 1918, Mr. Stimson was appointed general superintendent maintenance of way and structures of the Baltimore & Ohio Lines East.

Canadian Budget Provides For Public Work

The estimates for the financial year 1919-20 were presented to the Canadian House of Commons last week. They included unusually large appropriations for railways and public works. Estimated expenditure on capital account by the Department of Railways and Canals was $50,896,681, including the following items: Construction of and betterments to the Canadian Government Railways, $11,121,681; railway equipment and materials, $35,000,000; Port Nelson terminals of Hudson Bay Ry., $100,000; construction of Welland Ship Canal, $3,500,000; and construction and betterments of the Trent Canal, $1,000,000. There are also appropriations of $30,000,000 for the Government's shipbuilding program, and $348,930 for harbors and rivers in Ontario. A grant of $10,000 is made to the Canadian Engineering Standards Association for the promotion of uniformity of standards in metals and their products.

Hurley Reports Shipping Statistics

Chairman E. N. Hurley of the United States Shipping Board has released his report on a three months' visit which he has just completed in Europe, investigating the present conditions in the shipping industry of the world. It contains few facts or promises for the future of the American shipbuilding industry. Largely, it is devoted to statistics of shipping today, specifically outlining the prospects in the various maritime countries. It finally urges the necessity of the United States having a gross tonnage of 7,500,000 to take care of its prospective foreign trade, but the report gives no indication of what the policy of the Government will be with regard to future shipbuilding and ship ownership. A suggested policy will probably be made public by Mr. Hurley in a speech in New York Mar. 27.

Mr. Hurley says that there is a false impression in this country regarding the importance on a prospective merchant marine of the high wages required to be paid to seamen under United States laws. He says that not only do the leading shipping nations in the world pay just as high wages, but that wages are so small a proportion of the cost of operating a ship as to make them of small effect on total costs.

The statistics on present ship tonnage show that the total oceangoing tonnage of the world in 1914 was 41,295,000 gross tons. Today similar figures are 37,100,000 gross tons, the net loss of over 4,000,000 being due to the destruction of much more than that plus the increase due to production of ships during the four years of war. The falling off of normal increase by new construction which would have continued had the pre-war rate stood would amount to about 12,000,000 gross tons, so that there is today a shortage of 16,000,000 gross tons. In August, 1914, the United States seagoing merchant marine, 500 gross tons and over, included 624 steamers of 1,758,465 gross tons and 837 sailing vessels and schooner barges of 947,852 gross tons, making the grand total of 1490 seagoing merchant vessels of 2,706,317 gross tons. In November, 1918, the steam merchant marine had increased to 1366 vessels of 4,685,253 gross tons and the sailing vessels and schooner barges had decreased to 747 vessels of 829,917 gross tons, mak-

ing the grand total 2113 seagoing vessels of 5,515,180 gross tons. This does not include the seized enemy vessels, which at the end of the war averaged 88 vessels of 562,005 gross tons, of which number 81 are of 546,210 gross ton, steamers, and seven of 15,795 gross tons were sailing vessels. The total construction in the United States added to the merchant marine during the war amounted to 875 vessels of 2,941,845 gross tons.

Railroads Now Can Coöperate in Local Improvements

Although issued Dec. 30, 1918, the Railroad Administration order permitting the railroads to coöperate in local improvements does not seem to have had wide circulation, because a number of municipal authorities have recently written to Washington saying that local municipal projects were being held up because the railroads refused to assume their proportion of the cost. Circular No. 44, issued by the United States Railroad Administration July 29, 1918, permitted the railroads to refrain from coöperating in local improvements other than those of imperative necessity. This order has now been set aside, and such joint action on improvements should now be taken up by local municipal authorities in cooperation with the railroads, just as they were before the war.

No Freight Rate Reduction on Building Material

Freight rates on building material will not be reduced, according to an official statement of the Railroad Administration which reads as follows:

"Various inquiries have been received as to whether the Railroad Administration contemplates a reduction in freight rates on materials used in construction of buildings, and therefore it becomes important to make it clear that no such reductions are in contemplation. The Railroad Administration is, however, giving consideration to the question of making reduced rates on crushed rock, stone, sand, and gravel for road construction when consigned to and the freight thereon is paid by a Federal, State, county, parish, or township government. Before the matter can or will be definitely determined it is intended to ascertain what, if any, reduction necessary to establish a stable price will be made in the price by those producing and supplying the materials."

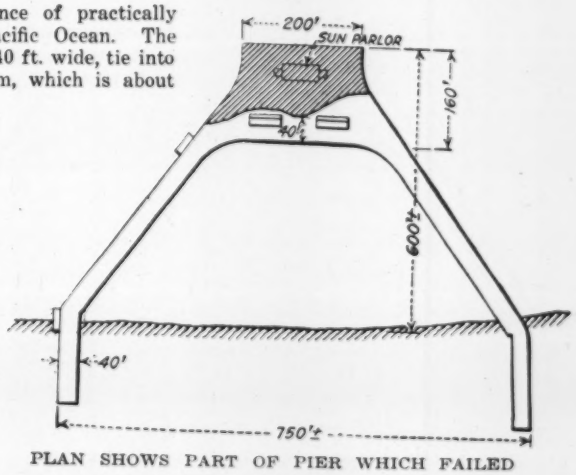
Highway Bond Issue for $30,000,000 Vetoed in Arizona

A bill clearing the way for a $30,000,000 bond issue for constructing roads in Arizona has been vetoed by the Governor. The bill provided for a highway commission of five members, and the objection of the Governor to this form of supervision is given as the reason for the veto.

Ocean Undermines Concrete Pier at Redondo Beach, California

The outer portion of the concrete pleasure pier at Redondo Beach, California, collapsed during a heavy windstorm on the night of Mar. 6. This pier, which was fully described in *Engineering News* of Sept. 14, 1916, p. 518, is in the form of a triangle extending out a distance of practically 600 ft. into the Pacific Ocean. The two legs, each about 40 ft. wide, tie into the outshore platform, which is about 160 x 200 ft. in plan. The structure was of reinforced-concrete girder and slab construction supported on reinforced-concrete piles which were jetted into place. It carried a sun parlor, an observation tower and other appurtenances.

DAMAGED OUTER END OF REDONDO BEACH PIER SHOWING COLLAPSED FLOOR WHERE PILING WAS WASHED OUT



PLAN SHOWS PART OF PIER WHICH FAILED

As shown on the diagram herewith, a large part of the outer section was washed away. At the present time, the failure of the pier is attributed to an unusual undertow washing the sand away from the piling. The end of the pier terminates at the head of a submarine cañon whose side and bottom slopes are very deep compared with the gradient of the surrounding ocean floor. There was a terrific undertow following the storm, and it is thought that possibly the cañon banks were affected by this action. The reinforced-concrete piles varied from 20 to 85 ft. in length; it is not known just how deep was their penetration, although it is thought that at the outer edge it was about 25 feet.

The City of Redondo is planning to repair the pier and has employed W. K. Barnard of Los Angeles to investigate the extent and cause of the damage.

Oregon Passes Highway Bond Issue for Ten Million Dollars

By utilizing an emergency provision, the legislature of Oregon, with the approval of the governor, has eliminated the necessity of putting to the vote of the people the measure providing for a bond issue of $10,000,000 for highway purposes.

This amount of money, which is thus made immediately available, when combined with the Federal aid to be received in the next two years and a portion of the $5,000,000 bond issue now being planned by the reconstruction committee of the legislature, will provide a large amount of money for highway work in the state during the coming year.

Exhibit of Army Personnel Work To Be Shown

Methods developed by the Committee on Classification of Personnel in the United States Army will be shown at an exhibit at the Engineering Societies Bldg., 29 West 39th St., New York City, Apr. 1-12, under the auspices of the National Association of Corporation Schools, the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers.

The exhibit consists of a collection of wall charts, forms, photographs and models showing how the Army finds out what men can do best and how it uses that information; how soldiers are trade tested, and how officers are rated and fitted into place; how the work is checked and supervised, and its results in the war. The exhibit was shown for several weeks at Washington, where it excited so much interest that, in response to many requests, the Adjutant General consented to its display in other cities. Two commissioned officers accompany the exhibit to explain its features.

Los Angeles Wants To Sell Cement Mill

The first and only municipal portland cement mill is now being offered for sale, as has been noted in several of the advertising pages of this journal. This is the Monolith mill built in 1908 by the City of Los Angeles, Calif., for the manufacture of cement to be used in the mammoth Los Angeles aqueduct. The plant is situated 117 miles north of Los Angeles, and includes contiguous and almost inexhaustible deposits of clay and limestone. The city has been in doubt for some time as to its disposition, but finally has decided that it cannot enter into commercial competition in the production of cement and that the mill is much too large for the needs of its own construction.

The mill is notable because it was utilized in the production of a tufa cement, using a volcanic deposit in close proximity to the mill. This blended cement required additions to the mill, so that today it has a capacity for a blended cement of about 1500 barrels.

Urges United Port of New York

In a paper read before the Society of Terminal Engineers Mar. 18, A. T. Skougor, engineer of the Chile Exploration Co. of New York, proposed a plan for a united port of New York and New Jersey which contained some features not hitherto included in similar projects. Mr. Skougor's preliminary contention is that a new state should be formed out of the districts immediately contributing to the port of New York, with the idea of furnishing one government and unified aims for the development of the port. He asserts that joint action will never amount to much. He urges that after such a state has been formed some engineer of national reputation be selected to plan, design and construct the port, having a free hand to select his staff, and that the port once having been developed, a Governor be appointed who will have full control of its administration.

In the design of this new port all efforts should be concentrated to divert from Manhattan Island all of the freight not essential to Manhattan, and that Manhattan shore should be used mainly as a passenger steamship port.

Engineers Will Discuss Federal Public Works Department

The Engineering Council through its National Service Committee has sent out invitations to 152 representative engineering societies of the United States, requesting the selection of delegates to attend a national conference on the establishment of a Federal department of public works. The conference is to be held in Chicago, Apr. 23-25.

With the invitation there has been sent to each society a general plan of organization for the conference and a statement of some of the principal questions which the conference will have to consider. It is requested that the societies take up these questions and, if they so desire, vote upon them, prior to the conference.

The calling of this conference follows close on the action of the Engineering Council on Feb. 20, 1919, advocating the establishment by Congress of a department of public works and urging engineers in all branches of the profession to use their influence to arouse public opinion so that the importance to the national welfare of such a department may be understood.

State Utilities Commission the Proper Agent

The State Supreme Court of Kansas has ruled that the Public Utilities Commission of the state is the proper means of compelling a utility company to give sufficient and efficient service. The decision was rendered in a suit brought by the City of Parsons against the Parsons Water-Supply & Power Co. to obtain the appointment of a receiver on the plea that the company had violated its franchise by not furnishing water in sufficient quantity and with sufficient pressure. The Supreme Court denied the application for a receiver and held that the courts will not decree specific performance so long as the proper remedy is offered through appeal to the Public Utilities Commission.

News Item on Appropriation for Federal Aid Corrected

Through an error, a news item announcing the passage of the Federal-aid highway appropriation for $200,000,000, which was published in *Engineering News-Record* Feb. 27, p. 446, was reprinted in the issue of Mar. 20, p. 592.

Civil Service Examinations

For United States Civil Service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

United States. — Senior highway bridge engineers, Apr. 1, Bureau of Public Roads, Department of Agriculture, Washington, D. C. Grade 1 (examination percentage above 70) $2400 to $2700 per year; Grade 2 (percentage above 80) $2800 to $3000 per year; Grade 3 (percentage above 90) $3100 to $3500 per year. File application before Apr. 1.

United States.—Engineer-draftsman, Apr. 22, $1500 to $1800 per year. File application before Apr. 22.

United States.—Transitman, $100 to $125 per month, and surveyor, $125 to $200 per month, Mar. 26-27 and Apr. 23-24. File applications in time to arrange for examination at place selected by applicant.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City.

The Albany Society of Civil Engineers will hold a meeting Mar. 27 at which R. E. Brooks, district manager for the Koehring Machine Co., will speak on "Modern Methods of Handling Material," with special reference to economy. The lecture will be illustrated by motion pictures.

The Engineers' Society of Milwaukee held its regular monthly meeting Mar. 19 under the auspices of the Milwaukee Section of the American Society of Refrigerating Engineers. J. R. Watson, of Chicago, spoke on "The Use of Synchronous Motors with Ammonia Compressors." Duncan Watson, M. I. E. E., alderman of London, England, and chairman of the Joint Conference on Electrical Undertakings of Greater London, addressed the meeting.

The Engineers' Club of St. Louis held a joint meeting Mar. 19 under the auspices of the St. Louis Association of Members of the American Society of Civil Engineers, at which Lieut. Col. F. G. Jonah, Engineers, U. S. A., previously chief engineer of the Department of Light Railways, American Expeditionary Forces, and now chief engineer of the St. Louis-San Francisco and the Missouri, Kansas & Texas Rys., spoke on the "Construction of Light Railways in France."

The Utah Society of Engineers held its monthly meeting Mar. 19. The following papers were presented: "Recent Improvements in Steam Prime Movers," by Prof. E. H. Beckstrand; "Modern Internal Combustion Engines," by Prof. A. L. Taylor; and "Water-Wheel Development," by L. M. Pharis, hydraulic engineer, Utah Power and Light Co. Calvin W. Rice, secretary of the American Society of Mechanical Engineers, will address the society Apr. 7.

The Engineers' Club of Philadelphia will hold an informal meeting Apr. 9 at which Roland L. Cummins, of the Packard Motor Car Co., will give a demonstration of the Liberty motor. The method of manufacturing Liberty motors will be illustrated by motion pictures. The regular monthly meeting will be held Apr. 15 and will be addressed by S. M. Swaab on "Main Interchange Station Under the City Hall, Philadelphia Subway System"; the address will deal with unique construction methods made necessary by conditions imposing exceptional difficulties. A special meeting will be held Apr. 23 at which Arthur J. Baldwin, vice-president of the McGraw-Hill Co., Inc., will present an illustrated paper entitled "The Devastated Area and Its Reconstruction." Mr. Baldwin was a member of a party of technical and business paper editors and publishers who were invited by the British Ministry of Information, as its guests, to visit Europe.

The American Water-Works Association's nomination committee has made the following nominations for office, which are now being voted on by mail: President, Carleton E. Davis, chief of the Bureau of Water, Philadelphia; vice-president, Capt. M. L. Worrell, Q. M. C., U. S. A., in charge of utilities at Camp Hancock, Georgia; treasurer, James M. Caird. W. H. Randall, superintendent of maintenance of the Water Department of Toronto, Ont., and F. C. Jordan, secretary of the Water Co. of Indianapolis, Ind., are the nominees for trustees.

The Vermont Society of Engineers was addressed by Maj. Gen. Clarence R. Edwards, commander of the Northeastern Department, U. S. A., at the annual meeting held at Burlington Mar. 12. John K. Hooper, meteorologist of the United States Weather Bureau station at Burlington, read a paper on "Rainfall in Vermont in 1918" and Charles H. Pierce, district engineer, United States Geological Survey, Boston, read an illustrated paper on "Stream Gaging in Vermont." Officers were elected for the ensuing year as follows: President, C. F. Purinton, Burlington; vice-president, F. D. Denison, St. Albans; secretary, G. A. Read, Montpelier.

The Indiana Society of Sanitary Engineers elected the following officers at the annual meeting in Terre Haute, Mar. 12: President, William J. Woolley; vice-president, E. Kanney; secretary-treasurer, Claude McElwaine.

The Ann Arbor Engineers' Club elected the following officers at the regular meeting Mar. 13: President, George H. Sandenburgh; vice-president, Robert Norris; secretary-treasurer, F. Leslie Feiner.

The Rochester Engineering Society was addressed Mar. 14 by Le Grand Brown, who delivered an illustrated lecture on "California." Miss Kate Gleason was the speaker at the luncheon Mar. 17. Leon R. Brown, New York State Railways, addressed the meeting Mar. 21 on "Taking Soundings in the Niagara River." The meeting Mar. 28 will be addressed by H. A. Winne, of the General Electric Co., on "Electric Furnaces."

PERSONAL NOTES

A. A. MATTHEWS, formerly chief engineer of the St. Louis Southwestern R.R. of Texas, has been appointed chief engineer of the group of railroads in the Southwestern region comprising the St. Louis Southwestern R.R., the St. Louis Southwestern R.R. of Texas, the Eastern Texas R.R., the Dallas Terminal Railroad and Union Depot, the Southern Illinois and Missouri Bridge and Louisiana and Arkansas Railroad.

GEORGE C. D. LENTH, for the past eight months general superintendent for the M. J. Corboy Co., on the construction of a sewer system and water-supply at Camp Henry Knox, Kentucky, has returned to his former position as assistant chief engineer of the Board of Local Improvements, Chicago.

LIEUT. F. E. SCHNEPFE, Construction Division, U. S. A., has received his discharge from the service and is now associated with the Lime Association as district engineer of the Southeastern District, with headquarters in Washington, D. C.

A. M. KRAMER, field engineer, Portland Cement Association, for western New York, has resigned to become affiliated with the Universal Portland Cement Co., with office in Pittsburgh.

LIEUT ADOLF HINRICHS, Engineers, U. S. A., has received his discharge from the service and has become secretary of the Woodbury Service, Inc., appraisal and production engineers, New York City.

FREDERICK WILLIAMS, junior engineer, Wilmington, N. C., has been transferred to the United States Engineer Office, Third District, New York City.

COL. SIDNEY B. WILLIAMSON, 55th Engineers, U. S. A., returned to this country Mar. 20 and has received his discharge from the service. He will resume his work as consulting construction engineer for Guggenheim Brothers.

CAPT. JOHN K. FLICK, Engineers, U. S. A., assistant to the Constructing Quartermaster, Curtis Bay Ordnance Depot, has been discharged and has become associated with Arthur Farmer, under the firm name of Farmer & Flick, engineers and contractors, 15 East Fayette St., Baltimore.

EDWIN B. BURCHARD, Office of United States Geological Survey, in Albany, has been transferred to the station at Ames, Iowa, where he will work in coöperation with the Iowa State Highway Department and the State Agricultural College.

P. H. WITHINGTON, A. B. ROBERTS and G. OTIS WRIGHT have become associated under the firm name of the Withington-Roberts-Wright Co., engineers, with main offices in the Swetland Building, Cleveland. Branch offices are located in Boston, New York, Baltimore and Chicago.

WILLIAM H. CUSHMAN has left the service of the Hydraulic Construction Co., Watertown, N. Y., and has opened offices in the Flower Building, as a consulting hydraulic engineer.

LIEUT. COL. WILLIAM C. SHERMAN, Corps of Engineers, U. S. A., who is an aviator and has been connected with the air service for some time, has been detailed as chief of Air Service Training, which will include heavier-than-air training at the ground schools and flying fields under Brig. Gen. William Mitchell.

LIEUT. W. G. SLOAN, 49th Engineers, U. S. A., stationed at general headquarters in France, has received his discharge from the service and has returned to his position as representative of the Irrigation Division, Bureau of Public Roads, United States Department of Agriculture, for Idaho and Eastern Oregon, with headquarters at Boise.

J. WENDELL MOULTON, Office of United States Geological Survey in Boston, has been transferred to the office in Albany, N. Y., replacing Edwin B. Burchard, transferred to Ames, Iowa, as noted elsewhere.

WARREN G. SWENSON, consulting engineer, of Pocatello, Idaho, has been appointed State Engineer of Idaho. After his graduation in civil engineering from the Utah Agricultural College in 1903, he entered the

service of the Utah Experiment Station, in charge of field operations and irrigation experiments. Later he became connected with the United States Reclamation Survey and afterwards served as engineer of the Telluride Power Co. In 1907 he became associated with the Beaver River Power Co. in charge of hydraulic engineering and construction, afterwards engaging in private practice, during which he has specialized in water-power and irrigation work.

CAPT. C. E. HICKOK, Engineers, U. S. A., who received his discharge from the service Jan. 1 and is now city engineer of Alameda, Calif., has been appointed major in the Engineers' Reserve Corps.

T. N. JACOB, civil engineer and specialist in land drainage and flood-prevention work, East St. Louis, Ill., has taken offices in the Boatmen's Bank Building, St. Louis, Mo.

GEORGE MOAGE, Wauseon, Ohio, has been appointed city engineer of Grand Haven, Mich.

W. S. MOORE, formerly city engineer of Grand Rapids, Mich., has become associated with the Simplex Mfg. Co., of Bethlehem, Penn.

MAJ. K. C. GRANT, Construction Division, U. S. A., has received his discharge and has returned to Dayton, Ohio, where he has become a member of the firm of Frank Hill Smith, Inc., engineers. Before entering the Army, in April, 1917, as a captain of engineers, he was division engineer for the Miami Conservancy District, with headquarters in Dayton.

MAJ. F. I. WHEELER, Corps of Engineers, U. S. A., has been discharged from military service and has returned to Cleveland to resume his duties as assistant engineer with Col. D. W. Lockwood, Corps of Engineers, in charge of the river and harbor district, embracing the lake shore of Ohio from Toledo to Conneaut. During the past year and a half Major Wheeler has been constructing quartermaster at Camp Johnston, Florida, and Camp Shelby, Mississippi, previous to which he was in charge of the construction of roads at Camp Sheridan, Alabama.

J. K. WILSON, of Grand Rapids, Mich., has become field engineer, Universal Portland Cement Co., with headquarters in Chicago.

CAPT. A. C. NELL, Construction Division, U. S. A., in charge of the purchase of power and mechanical equipment in the Construction Division, has received his discharge from the service and has been appointed Chicago district manager for the Lea-Courtenay Co. and the Schutte & Koerting Co. Captain Nell was formerly connected with the Allis-Chalmers Manufacturing Company.

IRA W. MCCONNELL, formerly works manager and assistant general manager, American International Shipbuilding Corporation at the Hog Island shipyard, has become vice-president of the Dwight P. Robinson & Co., Inc., constructing and consulting engineers, of New York City. After his graduation from Cornell University, in civil engineering, in 1897 he served two years as instructor and was afterward professor of civil engineering at the Missouri School of Mines. He later became connected with the United States Reclamation Service in charge of work on several projects, including the Uncompahgre project and the Gunnison tunnel. In 1909 he became chief irrigation engineer for J. G. White & Co., Inc., New York City, and was later appointed vice-president and general manager of the Idaho Irrigation Co. at Richfield, Idaho. In 1912 he became associated with Stone & Webster as a consultant.

WALTER RENTON INGALLS, for 14 years editor of the *Engineering and Mining Journal*, McGraw-Hill Co., Inc., has retired to reënter professional practice as a consulting engineer, with offices in New York City. However, he will not sever his connection with the *Journal*, but will continue to act as consulting editor and will remain in full charge of recording the weekly metal markets, making the quotations as heretofore. H. C. PARMELEE becomes acting editor without relinquishing the editorship of *Chemical and Metallurgical Engineering*, McGraw-Hill Co., Inc.

JAMES W. ROUTH, engineer, Rochester Bureau of Municipal Research, has been appointed director of the bureau, succeeding Le Roy E. Snyder, resigned. Mr. Routh has been associated with the bureau since its establishment four years ago, having previously been the principal worker in the preliminary survey of the local government. He had also been associated with the New York Bureau of Municipal Research. He is a graduate in engineering from the University of Minnesota and Cornell University.

D. T. BLACK, for eight years city engineer of Welland, Ont., has been appointed city engineer of Niagara Falls, Ont., succeeding Frederick Anderson, killed in action in France.

D. H. FLEMING, assistant city engineer of St. Catharines, Ont., has been appointed town engineer of Owen Sound, Ont.

W. L. STEVENSON, who from April, 1918, to the signing of the armistice, was sanitary engineer and assistant director of the Department of Health and Sanitation of the United States Shipping Board, and since then has been engaged in special work for the Emergency Fleet Corporation, has been appointed assistant chief engineer of the Pennsylvania Department of Health, with office at Harrisburg. He was previously assistant engineer in charge of investigations, reports, design and construction of intercepting sewers and sewage-treatment works of Philadelphia.

J. E. FERGUSON has opened offices in the Spitzer Building, Toledo, as a consulting and contracting engineer. Mr. Ferguson was formerly general manager of operation of the American Steel Co. of Cuba, previous to which he was general superintendent of the Toledo Bridge & Crane Co. of Toledo, Ohio.

CAPT. C. F. WAGNER, Engineers, U. S. A., has received his discharge from the service and has become chief engineer for the J. B. McCrary Co., Atlanta. Captain Wagner was supervising constructing quartermaster of coast defenses and later was officer in charge of construction, Camp Eustis, Virginia.

G. H. BISHOP, of Atlanta, has resigned as assistant sanitary engineer of the United States Public Health Service.

MAJ. RICHARD MESSER, Construction Division, Maintenance and Repair Branch, U. S. A., has received his discharge from the service and has returned to Virginia as chief engineer for the State Board of Health. He had charge of the section having general supervision over the operation of water-supplies, sewerage systems and treatment plants at cantonments, camps and other Army posts.

OBITUARY

E. K. LOVELACE, Cadillac, Mich., district engineer on the staff of the State Highway Engineer, died at Ann Arbor Mar. 6. He was at Ann Arbor in attendance at the university short course in highway engineering.

JESSE T. VOGDES, chief engineer and superintendent of Fairmount Park, Philadelphia, for 21 years, died in that city Mar. 18, at the age of 61. He entered engineering work in 1880 and became assistant engineer to General Thayer, who was chief engineer of Fairmount Park. The improvement of 34th St. in front of the Zoölogical Gardens, where the land was formerly a swamp, was begun and finished under his direction. He also superintended the construction of the East River drive from Lincoln Monument to the Wissahickon.

HARVEY M. GEER, consulting engineer, Ballston Spa, New York, died in Troy March 18. He was graduated from Rensselaer Polytechnic Institute in 1872, after which he entered engineering work and later became engaged in contracting. In 1876 he became assistant engineer on surveys for the water commissioner of Troy, and continued in municipal work. He had charge of the construction of water-supply systems in Johnstown, N. Y., Amsterdam, N. Y., Macon, Ga., and Westboro, Mass.

Price of Steel Lowered

Steel both in mill and warehouse has been reduced in price as a result of a joint meeting of representatives of the Iron and Steel Institute and the Industrial Board of the Department of Commerce, Mar. 20. The price of pig iron was lowered $4.25 per ton; steel, $7, at mill. The price of iron ore, $5.50 a ton, will remain the same. The object of the decrease is partially to restore business and industry to a peace basis.

The effect of this drop is already reflected by dealers. Beams and channels of 3 to 15 in., angles of 3 to 6 in., and 3-in. tees have declined from $4.07 in New York and Chicago to $3.47; plates, from $4.27 to $3.67.

At the conclusion of the conference, when the new schedule had been made public, Judge Gary said, "It is expected that prices for 1919 will not be any lower." This means that prospective buyers may go ahead with their projects, practically secure in the knowledge that iron and steel prices have been definitely fixed for this season.

Government Will Sell Accumulated Stock of Copper

Arrangements have been made by the War Department to sell a stock of approximately 100,000,000 lb. of copper, which it controls, at market prices, during the next 15 months. This is the result of an agreement with copper producers. The United Metal Selling Company, organized for the purpose by the producers, will handle the transaction.

For the first 10 months 5,000,000 lb. per month will be sold, and thereafter 10,000,000 lb. per month, until the stock is disposed of. The basis of the agreement is a stipulation that the producers shall absorb the stock at a rate equal to 10% of their sales. A small amount to cover the expense of sales is paid to the producers, and if market conditions improve the sales per month will be increased.

Plans for Utilizing Waste Explosives

When the munitions and shell-loading plants are finally closed, the Government will have on its hands hundreds of thousands of pounds of explosives consisting of scrapped TNT, amatol, ammonium nitrate, etc. Timothy D. Gleeson of New York, president of the Association of Practical Inventors of America, and formerly connected with the United States Ordnance Department as supervisor of plant safety and supervisor of amatol, has suggested several plans by which these explosives could be disposed of, and make unnecessary the plan some are advocating—that they be carried out to sea and dumped into the ocean. Instead of this wasteful procedure, he suggests that they should be utilized so that contractors, engineers, and farmers would obtain immediate benefit.

For example, farm acreage in meadows might be measured by blasting out stumps and undergrowth; new roads might be made in rocky regions; streams with soft mud bottoms might be deepened by scientifically exploding moderate charges at proper points. Along railroads, where slides of loose rock or earth occur, these menaces could be cheaply removed by these explosives, obtained at little or no cost. In many rivers and harbors are projecting reefs and movable sandbars that endanger navigation. These could be blasted out and removed.

Argentine-American Chamber of Commerce Formed

Formation of an Argentine-American Chamber of Commerce in New York City, under the auspices of the Chamber of Commerce of Buenos Aires, has been announced by Enrique Gil, secretary of the organization. Its purpose is to foster trade relations between the two countries, to encourage investment of American money in Argentina, and to serve as a clearing house for all business. The membership will include citizens of both countries.

BUSINESS NOTES

Amplex, Inc., New York and Tokio, announce that they will remove their New York office Apr. 1, to the 17th floor of 6-8 West 32d St. This firm acts as representative of American manufacturers in Japan and China.

W. J. Austin, general manager of the Austin Co., industrial engineers and builders, Cleveland, Ohio, has just returned after spending three months in France, Belgium and England. While in Europe, Mr. Austin and his party were guests of the British Government for a considerable time, visiting many sections and interviewing leaders of industry in foreign countries, and he believes that friendly conditions which have resulted on account of the war have already given American manufacturers a good start toward winning new markets in Europe. In the party were J. K. Gannett, export sales manager of the Austin Co., and Alvan T. Fuller, member of the House of Representatives from Massachusetts.

The Chicago Pneumatic Tool Co. announces the following changes in office locations and personnel: The Detroit office has been removed from 236 Hancock Ave. to 502 Farwell Bldg.; the Boston office has removed to 182 High St., and is in charge of F. S. Eggleston; offices have been opened with warehouses at Tulsa, Okla., and El Dorado, Kan.; J. I. Edwards has been appointed manager of rock drill sales, succeeding E. Eklund, recently appointed foreign representative; Fred H. Waldron, formerly stationed at Minneapolis, has been appointed manager of pneumatic tool sales, with headquarters in Chicago, succeeding J. G. Osgood, resigned; Nelson B. Gatch has been appointed manager of sales at the Minneapolis office, 301 Metropolitan Bank Bldg., and J. K. Haigh has been appointed assistant district manager of sales at 175 First St., San Francisco.

An organization, known as the Eastern Paving-Brick Manufacturers' Association, to advance the interests of paving-brick manufacturers of New York, Pennsylvania, Ohio and West Virginia, was perfected as a result of a meeting held recently at Harrisburg, Penn.

The Associated Metal Lath Manufacturers, who formerly had their offices in the Swetland Bldg., Cleveland, Ohio, have decided to move them to Chicago, Ill., the former home of Wharton Clay, who has been elected commissioner of the organization.

TRADE PUBLICATIONS

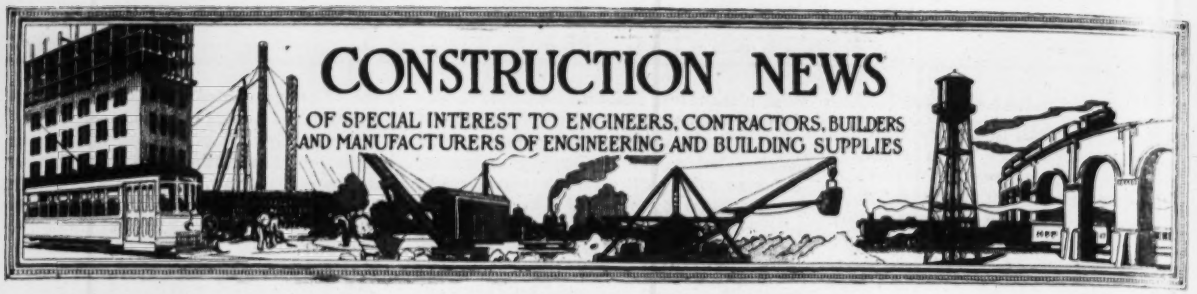
"Tarvia Road Book" is the title of a handbook just issued by the Barrett Co. for the use of engineers who are applying tarvia to their roads. It contains 70 pages, is 3½ x 6 in. in size, is neatly bound in leather and consists of tables useful to road engineers, together with specifications for applying tarvia. Among the tables are: The quantity of tarvia per mile; distance covered by various tank capacities; weight per cubic yard of various substances; spacing for covering material in half-ton piles; costs per mile at price per square yard, and many others. The book will be sent, on request, from any of the Barrett Co.'s offices.

"Pointers to Profits" is the title of a 7 x 10-in. catalog of 64 pp. just issued by the Acme Motor Truck Co. of Cadillac, Mich. Descriptions and illustrations of the operation of motor trucks, with specifications for sizes from one to five-ton capacities, are given.

Collapsible steel forms for concrete culverts from 13 to 15 in. to 36 x 46 in. in section are described in detail in a 24-p. pamphlet, 9 x 6 in., issued by the Illinois Culvert Form Co., Marseilles, Ill.

The Union Iron Products Co., of East Chicago, Ind., has issued a 3½ x 8½ in., 11-p. catalog illustrating "Wearproof" traffic direction signs, warning signs, metal highway markers and street nameplates. These signs are shown in colors and the accompanying descriptions give prices.

Cutting and breaking asphalt pavement and loosening frozen coal are two emergency uses for tie tampers described in the new Ingersoll-Rand tamping outfit catalog, which covers the company's outfits for track work.


CONSTRUCTION NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

PROPOSALS

For Proposals Advertised See Pages 64-70 inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Mar. 31	Bakerton, Pa. ..... Adv. Mar. 20 and 27.	Mar. 27
Apr. 1	Duncan, Okla.	Mar. 27
Apr. 1	Scottsbluff, Neb.	Mar. 27
Apr. 1	New York, N. Y.	Mar. 27
Apr. 9	Kansas City, Mo. ..... Adv. Mar. 20 and Mar. 27.	Mar. 27
Apr. 15	Duluth, Minn.	Mar. 13
Apr. 15	Freeport, O.	Mar. 27
Apr. 18	Akron, O. ..... Adv. Mar. 20 and Mar. 27.	Mar. 27

SEWERS

Mar. 31	Central Falls (Pawtucket P. O.), R. I.	Mar. 20
Apr. 1	Great Falls, Mont.	Mar. 20
Apr. 1	Harrison, N. J.	Mar. 6
Apr. 1	Newark, N. J.	Mar. 6
Apr. 1	Nutley, N. J.	Mar. 27
Apr. 2	MasonCity, Ia.	Mar. 27
Apr. 2	Brooklyn, N. Y.	Mar. 27
Apr. 2	Hamilton, Ont.	Mar. 13
Apr. 4	Trenton, N. J.	Mar. 27
Apr. 4	San Bernardino, Cal.	Mar. 27
Apr. 8	Hagerstown, Md. ..... Adv. Mar. 20 and 27.	Mar. 20
Apr. 17	Pawtucket, R. I.	Mar. 27
Apr. 22	Cleveland, O.	Mar. 27

BRIDGES

Apr. 1	Peterborough, Ont.	Mar. 13
Apr. 1	Ft. Dodge, Ia.	Mar. 20
Apr. 1	Kansas City, Mo.	Mar. 27
Apr. 2	Toronto, Ont.	Mar. 27
Apr. 4	Ottawa, Ill.	Mar. 27
Apr. 7	Adna, Wash.	Mar. 20
Apr. 7	Rawlins, Va.	Mar. 20
Apr. 7	Stella, Va.	Mar. 20
Apr. 8	Lewisburg, W. Va. ..... Adv. Mar. 13 t o 27.	Mar. 20
Apr. 8	Hillsboro, N. D.	Mar. 27
Apr. 9	Jellicoe, Ont.	Mar. 27
Apr. 10	Clarksville, Pa.	Mar. 20
Apr. 11	Holyoke, Mass. ..... Adv. Mar. 13 and 20.	Mar. 13
Apr. 15	Copper Valley, Va.	Mar. 20
Apr. 16	Ottawa, Ont.	Feb. 20
Apr. 22	Kingston, N. Y. ..... Adv. Mar. 20.	Mar. 20
Apr. 22	Toledo, O.	Mar. 27

STREETS AND ROADS

Mar. 28	Pennsylvania ..... Adv. Mar. 6 to Mar. 20.	Mar. 6
Mar. 31	Lockport, N. Y.	Feb. 6
Mar. 31	Ottawa, Ont.	Feb. 27
Mar. 31	Central Falls (Pawtucket P. O.), R. I.	Mar. 20
Mar. 31	Youngstown, O.	Mar. 20
Mar. 31	Maryland	Mar. 27
Mar. 31	Port Washington, Wis.	Mar. 27
Mar. 31	Elkhorn, Wis.	Mar. 27
Mar. 31	Wisconsin	Mar. 27
Mar. 31	Camden, N. J.	Mar. 27
Mar. 31	St. Paul, Minn.	Mar. 27
Apr. 1	Dodgeville, Wis.	Mar. 27
Apr. 1	Richland Center, Wis.	Mar. 27
Apr. 1	Lancester, Wis.	Mar. 27
Apr. 1	Perrysburg, O.	Mar. 27
Apr. 1	Newark, N. J.	Mar. 27
Apr. 1	Frankfort, Ky.	Mar. 27
Apr. 1	North Hatley, Que.	Mar. 27
Apr. 1	Raleigh, N. C.	Mar. 20
Apr. 1	Salt Lake City, Utah	Mar. 20
Apr. 1	Billings, Mont.	Mar. 20
Apr. 1	Kansas City, Mo.	Mar. 20
Apr. 2	Rhode Island ..... Adv. Mar. 20 and 27.	Mar. 27
Apr. 2	Fond du lac, Wis.	Mar. 27
Apr. 2	Mason City, Ia.	Mar. 2
Apr. 2	Michigan	Mar. 27
Apr. 2	Harrisburg, Ark.	Mar. 27
Apr. 2	Long Island City, N. Y.	Mar. 27
Apr. 2	Gold Beach, Ore.	Mar. 13
Apr. 2	Michigan	Mar. 13
Apr. 2	Santa Ana, Cal.	Mar. 13
Apr. 2	Boston, Mass.	Mar. 20
Apr. 2	Durham, N. C. ..... Adv. Mar. 20 and 27.	Mar. 20
Apr. 2	Bamberg, S. C.	Mar. 20
Apr. 3	Flemington, N. J. ..... Arv. Mar. 13 to 27.	Mar. 13
Apr. 3	New York	Mar. 20
Apr. 3	Pennsylvania	Mar. 27
Apr. 3	Lambertville, N. J.	Mar. 27
Apr. 3	Jonesboro, Ark.	Mar. 27
Apr. 4	New York	Mar. 20
Apr. 4	New Hampshire	Mar. 27
Apr. 4	North Platte, Neb.	Mar. 27
Apr. 5	South Dakota	Mar. 20
Apr. 5	Tylertown, Miss.	Mar. 20
Apr. 7	Moulton, Ala.	Feb. 20
Apr. 7	Salem, N. J. ..... Adv. Mar. 20 and 27.	Mar. 13
Apr. 7	San Jose, Cal.	Mar. 20
Apr. 7	Waukesha, Wis.	Mar. 27
Apr. 7	Camden, N. J.	Mar. 27
Apr. 7	Albany, N. Y.	Mar. 27
Apr. 7	Dothan, Ala.	Mar. 27
Apr. 7	Breckenridge, Minn.	Mar. 27
Apr. 7	Wahpeton, N. D.	Mar. 27
Apr. 7	Colorado ..... Adv. Mar. 20 and Mar. 27.	Mar. 27
Apr. 8	Mt. Vernon, Wash.	Mar. 20
Apr. 8	Indiana	Mar. 20
Apr. 8	Davenport, Wash.	Mar. 27
Apr. 8	Harlowton, Mont.	Mar. 27
Apr. 8	Pittsburgh, Pa.	Mar. 27
Apr. 9	Hackensack, N. J. ..... Adv. Mar. 13 to 27.	Mar. 13
Apr. 9	New Jersey ..... Adv. Mar. 13 to 27.	Mar. 20
Apr. 9	Center, N. D.	Mar. 20
Apr. 9	Providence, R. I. ..... Adv. Mar. 20 and 27.	Mar. 27
Apr. 9	Ithaca, N. Y.	Mar. 27
Apr. 10	Indiana	Mar. 20
Apr. 10	Middlebourne, W. Va.	Mar. 20
Apr. 10	Nevada	Mar. 27
Apr. 11	Jamestown, N. D.	Mar. 20
Apr. 11	Pennsylvania ..... Adv. Mar. 20 and Mar. 27.	Mar. 27
Apr. 11	Ebro, Minn.	Mar. 27
Apr. 12	La Moure, N. D.	Mar. 27
Apr. 14	Johnson City, Tenn.	Mar. 20
Apr. 14	Tunica, Miss.	Mar. 20
Apr. 14	Minneapolis, Minn.	Mar. 27
Apr. 14	Lincoln, Neb.	Mar. 27
Apr. 15	Billings, Mont.	Mar. 20
Apr. 15	Greenville, Miss. ..... Adv. Mar. 20 and 27.	Mar. 13
Apr. 15	St. Louis, Mo.	Mar. 20
Apr. 15	Columbus, Neb.	Mar. 27
Apr. 15	Keyser, W. Va.	Mar. 27
Apr. 15	Pawtucket, R. I.	Mar. 27
Apr. 16	Wayne, Neb.	Mar. 27
Apr. 19	Gandy, Neb.	Mar. 27
Apr. 22	Spencer, W. Va.	Mar. 13

RAILWAYS

Apr. 8	Pennsylvania ..... Adv. Mar. 20 and 27.	Mar. 27

EXCAVATION AND DREDGING

Mar. 31	Cleveland, O.	Mar. 20
Apr. 4	Whiteside, Ill. ..... Adv. Mar. 6 to 27.	Mar. 6
Apr. 8	Hollandale, Miss.	Feb. 13
Apr. 10	Newport, Ark.	Mar. 13
Apr. 15	Trenton, N. J. ..... Adv. Mar. 27.	Mar. 27

INDUSTRIAL WORKS

Apr. 1	Quebec, Que.	Mar. 13
Apr. 1	Sioux City, Ia.	Jan. 16
Apr. 1	Boonville, Mo.	Mar. 20
Apr. 1	Astoria, Ore.	Mar. 20
Apr. 5	Richmond, Va.	Mar. 27
Apr. 7	Hartford, Conn.	Mar. 27
Apr. 7	Brooklyn, N. Y.	Mar. 27
Apr. 10	Vancouver, Va.	Mar. 27
Apr. 14	Brooklyn, N. Y.	Mar. 27
Apr. 16	Winnipeg, Man.	Mar. 27
Apr. 16	Bellair, Ohio	Mar. 27
Apr. 18	Sheboygan, Wis.	Mar. 20
May 1	Brainerd, Minn.	Mar. 27

BUILDINGS

Mar. 31	Ottawa, Ont.	Mar. 6
Mar. 31	Mento, Ia.	Mar. 27
Mar. 31	Edgard, La.	Mar. 13
Mar. 31	Charlotte, N. C.	Mar. 20
Mar. 31	Chicago, Ill.	Mar. 20
Apr. 2	Fairfield, Cal.	Mar. 20
Apr. 2	Lansing, Mich.	Mar. 6
Apr. 2	New York, N. Y.	Jan. 23
Apr. 2	Duluth, Minn.	Mar. 20
Apr. 2	Lansing, Mich.	Mar. 20
Apr. 2	Chicago, Ill.	Mar. 27
Apr. 4	Seattle, Wash.	Mar. 13
Apr. 4	Compton, Cal.	Mar. 27
Apr. 4	Brooklyn, N. Y.	Mar. 27
Apr. 7	Ordway, Colo.	Mar. 20
Apr. 9	Jefferson, Ia.	Mar. 27
Apr. 10	Newaygo Mich.	Feb. 6
Apr. 10	Rome, N. Y.	Mar. 27
Apr. 10	Scottsville, Ky.	Mar. 27
Apr. 14	Superior, Wis.	Mar. 27
Apr. 15	Newark, N. J.	Feb. 6
Apr. 15	Chisholm, Minn.	Mar. 27
Apr. 15	Buhl, Minn.	Mar. 27
Apr. 21	Albany, N. Y.	Mar. 27
Apr. 22	Bovey, Minn.	Mar. 20
May 1	Wakefield, Minn.	Mar. 20
May 1	Virginia, Minn.	Mar. 27

FEDERAL GOVERNMENT WORK

Mar. 31	Wall and Dock—Spec. 3726 —Coddington Point, R. I.	Mar. 27
Mar. 31	Coal—Memphis, Tenn. ..... Adv. Mar. 6 to Mar. 20.	Feb. 27
Mar. 31	Dredging—Wilmington, Del. ..... Adv. Mar. 6 to 27.	Mar. 6
Mar. 31	Power Plant Improvements —Spec. 3389 — Pensacola, Fla. ..... Adv. Mar. 13.	Mar. 13
Mar. 31	Boathouse—Spec. 3786— Newport, R. I.	Mar. 20
Mar. 31	Dredging—Spec. 3597—Ft. Lafayette, N. Y.	Mar. 20
Mar. 31	Quay Wall, etc. — Spec. 3726—Newport, R. I.	Mar. 20
Mar. 31	Cranes — Spec. 3794 — Alexandria, Va.	Mar. 20
Apr. 1	Cement—Conneaut Harbor, O.	Mar. 13
Apr. 2	Post Office—Honey Grove, Tex.	Mar. 6
Apr. 2	Sewer and Water Supply —Stapleton, N. Y.	Mar. 13
Apr. 4	Post Office—Eldorado, Kan.	Mar. 6
Apr. 4	Bear Trap Leaves—Cincinnati, O. ..... Adv. Mar. 6 to 27.	Mar. 6
Apr. 4	Rip-Rap—Block Island, R. I.	Mar. 27